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DOE/NASA CONTRACTOR  
REPORT

DOE/NASA CR- 161797

SOLAR HEATING AND HOT WATER SYSTEM INSTALLED AT  
ARLINGTON RACQUETBALL CLUB, ARLINGTON, VIRGINIA -  
FINAL REPORT

Prepared from documents furnished by

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For the U. S. Department of Energy



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**U.S. Department of Energy**



**Solar Energy**

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## THE ARLINGTON RACQUETBALL/HANDBALL CLUB SOLAR ENERGY SYSTEM

### Acceptance Test Plan

The Acceptance Test Plan is documented to provide a clear understanding of the operation of the Solar Energy System. Documentation will include:

- I. Modes of Operation
- II. Test Procedures
- III. Maintenance Procedures
- IV. Maintenance Checklist

The Solar Energy System at the Arlington Racquetball Club, Arlington, VA, is designed to provide service hot water and space heating for the support areas of the facility (main desk, lounge, locker rooms). The Solar Energy System consists of a closed loop, forced circulation exchange system between the solar collectors (on roof) and the Solar Storage Tank (at parking level). The heat transfer is provided by means of a U-pass heat exchanger located in the bottom third of the Solar Storage tank. The Service Hot Water System consists of a preheat coil located in the top third of the Solar Storage Tank. The preheated service hot water is supplied to the existing electric water heaters (3), by means of a recirculation loop. The Space Heating System consists of solar heated water in the Solar Storage Tank being pumped to the water-to-air heat exchangers (2) located within the existing electric heating/cooling system. The water-to-air heat exchanger is located in the return air duct on the existing court level heating/cooling system. The second water-to-air heat exchanger is located in the supply air duct of the existing upper level heat/cooling system. Each of the systems operate independently of the other, by means of a motor operated zone valve (at parking level).

The Solar Energy System, The Service Hot Water System, and The Space Heating System operate independently of the other. The existing electric back-up system will maintain continuity of service.

### I. Modes of Operation

#### A. The Solar Energy System

The system consists of 2,520 sq. ft. of flat plate solar collectors and a 4000 gallon Solar Storage Tank. The transfer medium in the forced-closed loop is a non-toxic antifreeze solution (50% water, 50% propylene glycol).

##### 1. Charging the Solar Storage Tank

The pump used to transfer solar-heated fluid from the solar collector to the heat exchanger in the Solar Storage Tank is controlled by a differential controller and two (2) remote

temperature sensing devices. One sensor  $Ts_1$  is located at the solar collector (mounted on an absorber plate). The second sensor  $Ts_2$  is located in the bottom third of the Solar Storage Tank. When the temperature of the solar collector ( $Ts_1$ ) exceeds the temperature of the Solar Storage Tank ( $Ts_2$ ) by  $10^{\circ}$  F, the differential controller will energize the pump and transfer the solar heated fluid to the heat exchanger in the Solar Storage Tank. When the temperature of  $Ts_2$  is equal to that of  $Ts_1$ , the differential controller will de-energize the pump.

## 2. The Service Hot Water System

The system consists of a preheat coil (60 ft. of  $1\frac{1}{4}$ "  $\theta$  copper tubing) located in the upper third of the Solar Storage Tank and a recirculation loop between the preheat coil and the existing electric water heaters.

### a) Charging the Service Hot Water System

Service cold water is supplied directly to the preheat coil. Heat is transferred from the solar heated fluid in the solar storage tank to the service cold water in the preheat coil. The preheated hot water is supplied to the existing electric water heaters. The existing electric water heaters will maintain delivery temperature at  $120^{\circ}$  F minimum.

### b) Operating the Re-circulation Loop

The pump used to circulate service hot water from the preheat coil to the existing water heaters will be energized continuously and will de-energize by means of a high temperature cut-off switch.

## 3. The Space Heating System

The System consists of two (2) separate water-to-air heat exchangers located in the ducts of the existing space heating/cooling systems. The heating water will be supplied from the Solar Storage Tank.

### a) Space Heating with Solar Heated Water

The pump used to transfer heating water (solar heated) from the Solar Storage Tank to the respective water-to-air heat exchanger will be controlled by an existing remote space thermostat. When there is a call for space heating, the existing remote space thermostat will energize the pump and the respective zone valve to supply heating water to the water-to-air heat exchanger. When space temperature is satisfied the pump and the zone valve will de-energize. If the solar portion of the space heating system does not satisfy space heating requirements, the existing electric heating system will energize to satisfy space heating requirements.

## II. Test Procedures

### A. Solar Energy System

#### 1. Solar Energy System Pump

- a) Operate electrical switch manually to the "on" position. The pump will energize.
- b) Operate electrical switch manually to the "off" position. The pump will de-energize.
- c) Operate electrical switch manually to the "auto" position. Place switch in this position for system operation.

### B. The Differential Controller

1. Test the operation of the differential controller by providing temperature differentials across the sensors  $T_{s_1}$  (at solar collector) and  $T_{s_2}$  (at Solar Storage Tank). When  $10^{\circ}\text{F}$  set temperature differential is achieved, the pump will energize. When the temperature differential is  $0^{\circ}\text{F}$  the pump will de-energize.

### C. The Solar Loop

1. Maintain 30 psi (minimum) pressure in the Solar Loop.

### D. Service Hot Water System

#### 1. The Service Hot Water Pump

- a) Operate the electrical switch manually to the "on" position. The pump will energize.
- b) Operate the electrical switch manually to the "off" position. The pump will de-energize.
- c) Operate the electrical switch manually to the "auto" position. Place switch in this position for system operation.

#### 2. High Temperature Cut-Off Switch

Test the operation of the High Temperature Cut-Off Switch by providing the set limit temperature to the sensing device. When high limit temperature is achieved, the Service Hot Water Pump will de-energize. When the temperature is below set high limit, the Pump will energize.

## E. Space Heating System

### 1. The Heating Water Pump

- a) Operate the electrical switch manually to the "on" position. The pump will energize.
- b) Operate the electrical switch manually to the "off" position. The pump will de-energize.
- c) Operate the electrical switch manually to the "auto" position. Place the switch in this position for system operation.

### 2. Existing Space Thermostat

Test operation of the Space Heating System by providing a call for space heating. The heating water pump and the respective zone valve will energize. When space temperature is achieved, the heating water pump and the respective zone valve will de-energize.

## III. Maintenance Procedure

### A. Solar Collection System

The system operating pressure is 30 psi (minimum). If pressure falls below set psi, de-energize system and repair leak(s).

1. If the leak(s) is in the solar collector panel, isolate the "group" of collector panels (6) from the system. Drain the group and repair the leak(s).
2. Isolate the heat exchanger at the Solar Storage Tank by closing the gate valves. Check for pressure loss in the closed loop. If there is no loss of pressure within 6 hours, remove heat exchanger and repair the leak(s).
3. Isolate the solar collector and the heat exchanger by closing the gate valves. Check for a pressure drop in the closed loop piping. If there is a loss of pressure in 6 hours, repair leak(s) as required.

### B. Service Hot Water System

The System operates off County water pressure 30 psi to 150 psi maximum.

1. If leak(s) occur in the system, isolate the system from the cold water supply, drain the system to repair the leak(s).
2. During the repair of the system, open the by-pass valves to supply cold water to the existing water heaters.

3. Isolate the heating coil at the Solar Storage Tank by closing the gate valves. Check system for a pressure drop in the service hot water recirculation loop. If there is no loss of pressure, remove the heating coil and repair the leak(s).
4. If the fluid level in the Solar Holding Tank increases, isolate the heating coil. If the level does not increase over 6 hours, remove the heating coil and repair leak(s).

#### C. Solar Space Heating System

The system operating pressure is 20 to 40 psi.

1. If the fluid level in the Solar Holding Tank falls below set level, close the cold water fill valve, de-energize the system and check the fluid level over a 6 hour period. Isolate the Solar Storage Tank and check the Fluid level. If the fluid level decreases over a 6 hour period, drain the Solar Storage Tank and repair the leak(s).
2. Check for leak(s) in the piping and the water-to-air heat exchangers after isolating the solar storage tank, by checking the pressure.

### IV. Maintenance Checklist

#### A. Solar Collecting System

- Check collectors and roof top pipes for visual signs of leak(s) every 24 hours.
- Check percentage of antifreeze in solution in closed loop prior to winter season. Replace every two years.
- Service pump bi-annually.
- Clean system strainer bi-annually.
- Wash solar collector glazing every 3 months to eliminate dirt and grit build-up on the glazing.
- Check flashing at collector supports for cracks and leaks bi-annually.
- Check (and reset if necessary) circuit setters annually.

#### B. Service Hot Water System

- Service pump bi-annually.
- Clean system strainer bi-annually.
- Check operation of electrical service bi-annually.
- Drain and flush clean the heating coil annually.

#### C. Solar Space Heating System

- Check fluid level in the Solar Holding Tank every 24 hours.
- Service pump and zone valves annually.
- Clean system strainer bi-annually.
- Reset (if necessary) fill valve bi-annually.

-Check operation of electrical service bi-annually.  
-Drain and flush clean Solar Storage Tank and water -to-air heat exchangers annually (during the non-heating season).

- D. Check solar collector mount system every 24 hours.
- E. Touch-up painting, as necessary, on collector mount system annually.
- F. Check all bolts and connections on collector mount system bi-annually.
- G. Spot check all systems after severe weather conditions.

## ARLINGTON RACQUETBALL/HANDBALL CLUB

### CONTROLS FOR THE HOT WATER SOLAR SYSTEM

#### Domestic Hot Water:

The domestic hot water feeds through heat exchanger in the tank as the hot water is consumed. The P2 circulator pump will run continuously. T1 control stat, will de-energize P2, when the loop temperature rises above 140° F. When the loop temperature falls, the system reverses.

#### Locker Room Heating:

DC2 temperature sensors are located, at S3, to monitor the hot water tank temperature, and at S4, to monitor the temperature after water has passed through the Q dot coil of the locker room's HVAC system. On a call for heat, R1 contact closes (S3 is 10° higher than S4), V2 opens and M2's motor triggers the switch to start P3. When the differential temperature falls, the reverse occurs.

#### Lobby Unit Heat Operation:

On a call for heat, R2 contact closes, T3, located in the tank, set at 75° adjustable, opens V1 and the M1 motor end switch will energize P3 pump. Hot water will be pumped to the heating water coil located in the lobby unit return. When the water temperature falls below the set point, the motor de-energizes.

#### Solar Loop Sequence of Operation:

DC1, temperature sensors, S1 and S2, monitor the solar collector and hot water storage tank temperatures. When S1 is 6° (adjustable) higher than S2, the DC1 contact closes, allowing the solar pump, P1, to start. With a fall in temperature, P1 de-energizes.

#### Pressure Alarm:

When PS1 pressure control (30 lb adjustable) does not sense pressure on starting of P1, by the DC1 controller, it energizes an alarm indicating a loss of water in the solar loop.

#### Temperature Alarm:

When the hot water tank temperature rises up to 200° F (adjustable) T2 energizes an alarm indicating over temperature.

Letter Code:

DC - Differential Controller  
S - Temperature Sensor  
T - Thermostat  
R - Relay  
P - Pump  
M - Valve Mtr.  
V - Valves  
PS - Pressure Switch

V1 - Lobby Unit Hot Water Valve  
V2 - Locker Room Unit Hot Water Valve  
M1 - Lobby Valve Mtr.  
M2 - Locker Room Units valve Mtr.  
T1 - Domestic Hot Water Stat, T 675  
T2 - Tank Temp. Stat At Over Temp., T 678  
T3 - Tank Temp. Stat, T 675



# SUNWORKS

## internal manifold Solector®

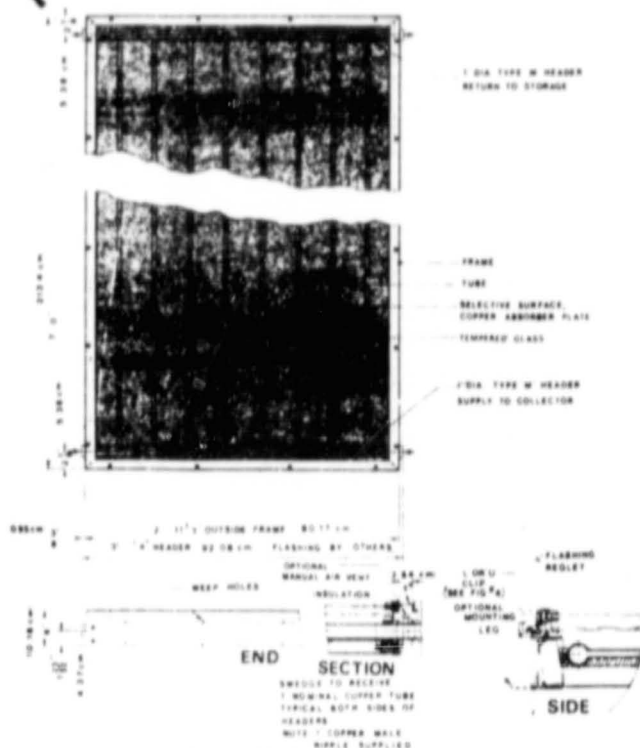


FIGURE 1

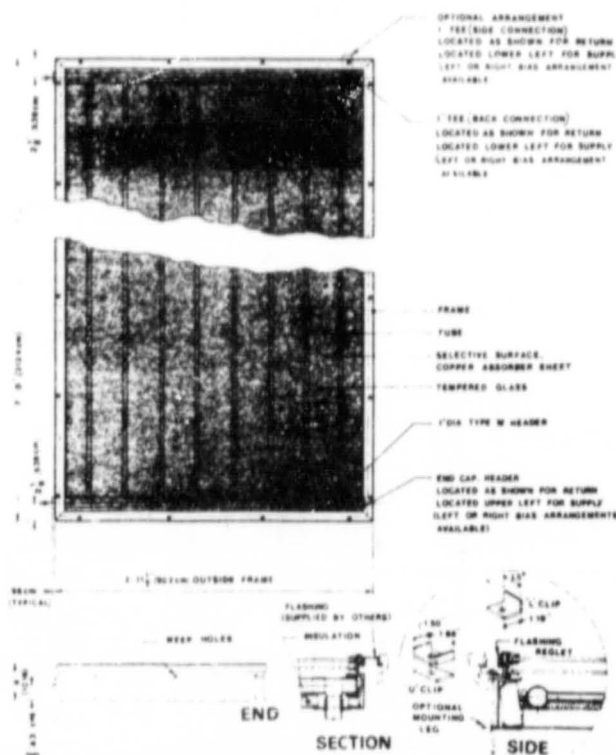


FIGURE 2

The 3' x 7' liquid cooled Solector solar energy collector, with internal manifolding and side, side/back or side/end connections allows for a multi-panel array to be coupled in parallel or parallel series before returning to the main supply or return branch. This results in fewer field connections and fewer piping accessories while retaining a high installed net to gross ratio, approximately 88 percent. The internal manifold liquid cooled Solector is available with connection locations that allow side-by-side mounting for parallel flow or end-to-end mounting for series flow. This Solector configuration responds to the specific design requirements of solar collector arrays for commercial, industrial, and institutional building types by maximizing the amount of collectors able to be placed onto the structure while minimizing the installed cost.

### FEATURES AND CONSTRUCTION:

**Cover:** Single glazing: lo-iron (A.S.G.), 1/4 in. (.32 cm) tempered, edges swiped. Double glazing: lo-iron (A.S.G.), 2-1/4 inch (.32 cm) tempered, with weep holes. Total transmissivity: Single glazing, 89.1%; Double glazing, 79.3%. (A.S.G. 1/4" or 1/2" no iron also available.)

**Absorber Container:** Sides, aluminum extrusion; rear aluminum sheet .032 inches (.058 cm) thickness, pop rivet in place.

**Air Space Between Cover and Absorber:** Approximately 3/4 to 1 inch depending upon glazing type.

**Gasketing Material:** EPDM "U" gasket for glazing, closed cell elastomer, compressible high temperature silicone seal for absorber sheet.

**Weatherproofing:** This module can be placed out in the weather without need for further weatherproofing.

**Finish on Aluminum Sides of Container:** Standard mill finish, anodized clear or baked black enamel (available at extra cost).

**Dimensions of Surface-Mounted Module:** Outside dimensions overall: 35 1/2 inches (90.2 cm) wide x 84 inches (213.4 cm) long x 4 inches (10.2 cm) thick (add 1 1/4 inch each end for optional continuous mounting bracket). Effective absorber area = 18.50 ft<sup>2</sup> (1.72m<sup>2</sup>). Ratio of usable absorber area to total installed surface covered = 0.88. Glass area (aperture) = 18.88ft<sup>2</sup> (1.75m<sup>2</sup>).

**Absorber:** Copper sheet: 0.010 inches thick (.025 cm) (7 ounces). Selective black: minimum absorptivity, .85/.92; maximum emissivity, .15/.35. Manufactured by Enthone, Incorporated; guaranteed durable to 400°F (305°C). (Black chrome: absorptivity, .94 emissivity, .12 also available.) Copper tubes: 1/2" O.D., 4 inches (10.2 cm) on center, L-type copper. Tube pattern: grid. Bond between tube and sheet: high temperature solder, 270° wrap. Manifolds: 1 inch type M copper. Tube connections to manifold: brazing alloy. Connection to external piping: 1 inch type M copper tube. Manifold/tubes pressure tested before leaving factory to 15 atm; recommended 125 psig (8.5 atm) working pressure.

**Insulation Behind Absorber:** .5 in. (1.25 cm) thick glass fiber (compressed) over 1.0 inch (2.5 cm) thick foil-faced isocyanurate, R = 10.0, (glass fiber, 1.2 lbs/ft<sup>3</sup> density).

**Method of Anchoring:** Keyway integral to collector frame continuous along perimeter of frame designed to accept "L" or "U" clips with predrilled 1/4" diameter hole for bolt mounting to roof or frame. Optional 1/4 inch (3.2 cm) mounting leg integral with top and bottom of frame; four 1/2" (.95 cm) diameter holes predrilled. Capability of through bolt anywhere along its length.

**Weight Per Module:** 123 pounds (55.8 kg), filled; 120 pounds (54.4 kg), empty (standard 3' x 7' unit). Add 27 pounds (12.2 kg) for double glazed unit. The liquid in the solector is equal to 0.48 gallons (1.82 liters).

**Recommended Flow Rate Through Collector:** 28 lbs/ft<sup>2</sup>/hr (1 gpm) (.063 l/sec) per collector.

**Collector Coolant:** Coolant should be Sunsol 60, made by Sunworks or equivalent. In areas where regular tap water is used as a coolant, it is important that the pH be controlled between 6.5 and 8, and the Ca. Mg. count should be below 50 ppm.

**Warranty:** Five year material workmanship warranty on all parts effective from date of installation. See your local Sunworks representative for further details.



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## SUNSOL 60

Sunsol 60 is a non-toxic, non-flammable heat transfer media for solar collectors. It contains special corrosion inhibitors that will protect the life of the copper and steel components of solar heating installations.

Sunsol 60 also contains a certified non-toxic dye for easy identification of leaks that may occur in the system.

Sunsol 60 can be used as is, undiluted. It will protect the installation against freezing to a temperature of -55°Fahrenheit. For areas where the minimum winter temperature is higher, water may be added following the instructions of Table I.

**TABLE I**

Minimum Temperature	Sunsol 60	Water	Final Solution Volume
-55°F	5 gal		5 gal
-40°F	5 gal	0.5 gal	5.5 gal
-20°F	5 gal	1 gal	6 gal
0°F	5 gal	1.75 gal	6.75 gal
10°F	5 gal	5 gal	10 gal
20°F	5 gal	10 gal	15 gal

SPECIALISTS IN SOLAR ENERGY EQUIPMENT

A-2

DIVISION OF  
**ENTHONE**  
INCORPORATED  
WEST HAVEN, CONNECTICUT

A subsidiary of **ASARCO**

## SPECIFICATIONS

**SPECIFIC GRAVITY:** 8.7 lbs/gallon

**VISCOSITY:**

0°C	.....	40 cps
20°C	.....	10 cps
40°C	.....	4 cps

**SURFACE TENSION:** 25°C ..... 42.5 dynes/cm

**VAPOR PRESSURE:** 20°C ..... 12 mm Hg

**SPECIFIC HEAT:**

25°C	.....	.808
50°C	.....	.833
70°C	.....	.857

**BOILING POINT:**

1000 mm	.....	116°C	.....	240°F
760 mm	.....	109°C	.....	228°F
300 mm	.....	82°C	.....	180°F

**FLASH POINT:** NONE

**TOXICITY:** Non-toxic; contains no hazardous ingredients

Our recommendations are made in good faith and are based on our skill and experience. However, since the conditions of use of these products are beyond our control, this information is given on the express condition

and agreement that Enthone, Inc., will not be liable to any person by reason thereof. Nothing herein shall be deemed to be a recommendation to use any product in violation of any existing patent rights.

Available in 5 and 55 gal. containers.  
See your Sunworks Representative for pricing and shipping.  
Manufactured by Enthone, Inc.

Measure "X" to the nearest 1/16"

- c) Clean 4 - 2" pieces of 1" type M Copper Tubing with emery cloth. Place a mark with tube cutter 1/4" in from the end of the tube. See Fig. 3.

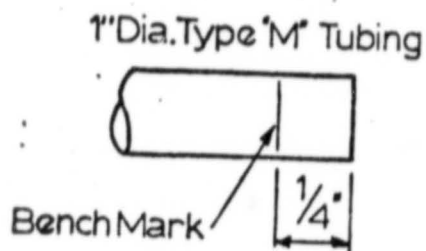


Figure 3

- d) Cut the connecting male couplings in the middle with a thin hack saw blade. Avoid Damage to the Swedges.
- e) Remove collector "B" from the array.
- f) Remove stubs from collectors "A", "B" and "C" and any solder remaining in the swedges. Emery cloth or wire brush is helpful.
- g) Apply flux to all swedges.

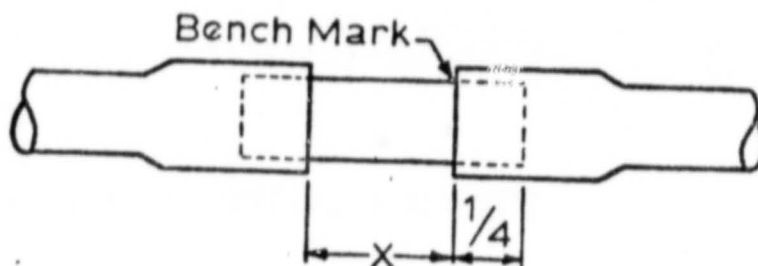


Figure 5

- l) Use needle nose pliers or similar tool to move connector nipple into position.
- m) Repeat for all other connections
- n) Solder connections with 95/5 tin antimony.
- o) Check for leaks by pressurizing system.

NOTE:

A generous quantity of flux paste on the connecting nipple and in the swedges will permit the nipple to slide into position easily. A channel-lock plier may be used instead of needle point pliers.

## REPLACING A SELECTOR MODULE

- 1) Collectors at the ends of an array can be easily removed.
- Removal from the other locations can be accomplished as follows:

- a) Assume Selector "B" is to be removed. See Fig. 1.

1" Dia. Nipple Typ. 4 pls.

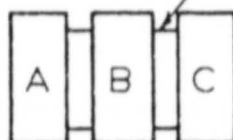


Figure 1

- b) Accurately measure the distance between the swedges. (The length of the exposed connecting nipple) See Fig. 2.

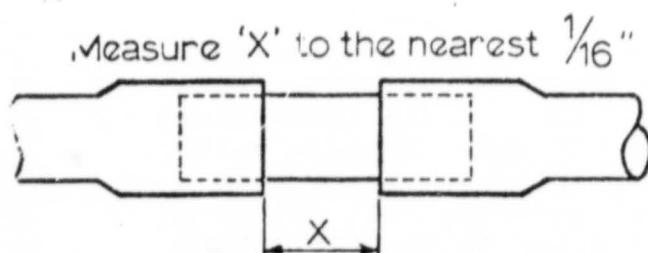


Figure 2

- b) Cut the 4 pieces of Type M tubing  $1/2"$  longer than the measurement "X". The  $1/4"$  bench mark is included in the overall dimension ( $1/2"$  plus "X".)

- 1) Insert the four (4) male coupling nipples into the swedges of collector "B" until they stop. See Fig. 4.

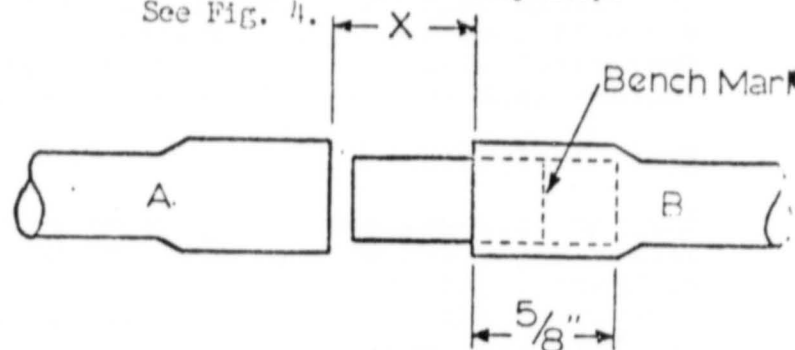


Figure 4

Example: Assume "X" =  $1/4"$   
Add  $1/2"$   
Nipple Lg. =  $3/4"$

Nipple shown in stepped position.

- j) Carefully place collector "B" into position. Note there is only  $1/8"$  gap between end of header swedge and edge of nipple. See Fig. 4.
- k) Align swedge of adjacent collector with coupling nipple and slide nipple into swedge until bench mark is in alignment with edge of swedge. See Fig. 5.

## Sequence of Operation

### Citizens Mutual Savings & Loan

#### Solar Storage Summer

If ambient temperature within solar collector is less than  $100^{\circ}$ , valve V-1 is open to storage tank "W". If Solar collector temperature is above  $100^{\circ}$  then valve position is determined by Delta Temperature controller. If temperature difference between sensors is less than  $20^{\circ}$  the diverting valve V-1 is open to storage tank "W".

#### Solar Storage Winter

If storage tank "W" temperature is  $195^{\circ}$  or greater the diverting valve V-2 will position to allow water to go into storage tank "C". Outdoor thermostat will position diverting valve to allow water to go into storage tank "C" anytime outdoor temperature is below  $60^{\circ}$ .

#### Heat Dissipation

Anytime storage tank "W" temperature T-2 is  $200^{\circ}$  or greater, then diverting valve V-3 will open to allow flow through heat dissipation heat exchanger, and will start condenser water pump. Interlock will prevent operation of absorption units and water-to-air heat pumps if storage tank "W" temperature is  $200^{\circ}$  T-2 or greater.

#### Domestic Water Heating

Sensor in water leaving heat exchanger HE-2 will position (modulate) mixing valve V-5 to maintain set point of  $120^{\circ}$ . Set electric element thermostat in domestic electric water heater at 115o.

#### Solar Pumps P5, P6, P7

If ambient temperature within solar collector is  $100^{\circ}$  or greater then all solar pumps will be started through time delay relay. Time delay relay is set for 15 minutes to prevent short cycle. Delta temperature controller through sensors in solar water and hot water heating water will cause solar pumps (3) to stop if solar water is not  $5^{\circ}$  or more higher than H.W. heating water. On a call for cooling, P.E. switch will cause solar pumps P6 and P7 to stop. If solar water temperature rises to  $207^{\circ}$  then solar pump P6 will restart and a continued rise in solar water temperature to  $210^{\circ}$  will cause solar pump P7 to restart.

Hot Water Heating Pump is started by auxiliary contacts in solar pump P5 starter or by temperature controller in storage tank "W" set at  $60^{\circ}$  if the supply fan is running and there is a call for heating or cooling.

Space heating and cooling - Heating and cooling control functions for each of the 5 zones are initiated from the respective space thermostat for each zone. The control functions for each zone space thermostat shall be identical as herein described and as indicated in the diagrams. The 7-day program time clock shall provide "night" setback for nights and weekend days for selected days and selected hours as directed.

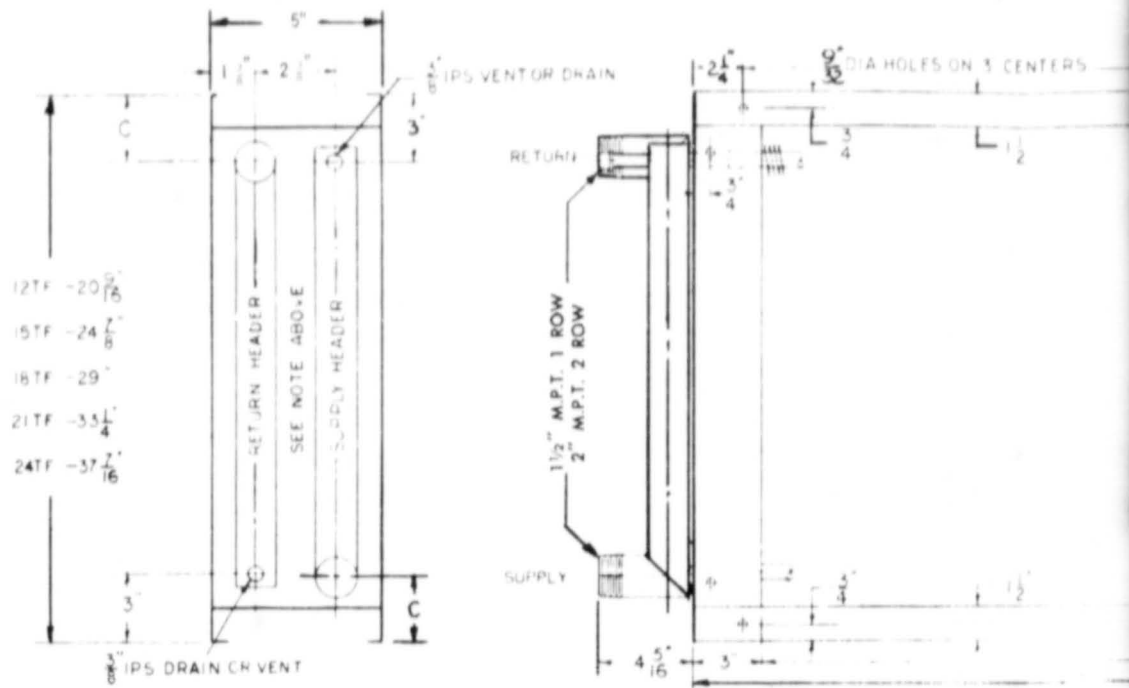


# The Rust Construction Co., Inc.

## OPERATION AND MAINTENANCE OF SUNWORKS SOLAR COLLECTORS

1. The collectors should be seasonally washed with water to remove any thin film of dirt from the glass coverplate. It may be necessary to do this only two or three times a year, as rain also accomplishes this purpose. If inspection determines that dirt accumulates more than expected and does not come off with hose spray it may be required to lay a long ladder vertically over the collector frames and clean the glass with water and a non-soapy ammonia mixture, such as a glass cleaning fluid.
2. Once a year a small amount of the solar loop fluid should be drawn off and analyzed for its PH content. It should be maintained between 5.5 and 8 PH. It may be necessary to replace the non-freeze solution every three years. The Sunsol 60 non-freeze solution is basically a propylene glycol that is non toxic. This solution has non corrosion additives that inhibit the corrosion that may occur from piping. The strength of the solution is designed for protection against freezing to -20 F.
3. Should it be necessary to replace a collector due to some unforeseen damage, the attached sheet gives the installation instructions.
4. A list of parts can be obtained from the mechanical installer or the local Sunworks representatives.
5. A specification sheet on the collector and on the Sunsol-60 non-freeze solution is attached.
6. The special Department of Energy Warranty on solar collectors for this installation will be furnished within the next two weeks.

ON 2 ROW COIL  
CONNECTIONS SHOWN FOR  
AIR FLOW LEFT TO RIGHT.  
FOR AIR FLOW RIGHT TO LEFT  
ROTATE COIL 180°.



Nominal Tube Length	2'-0"	2'-6"	3'-0"	3'-6"	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	8'-6"	9'-0"
A	2'-4 1/2"	2'-10 1/2"	3'-4 1/2"	3'-10 1/2"	4'-4 1/2"	4'-10 1/2"	5'-4 1/2"	5'-10 1/2"	6'-4 1/2"	6'-10 1/2"	7'-4 1/2"	7'-10 1/2"	8'-4 1/2"	8'-10 1/2"	9'-4 1/2"
B	22 1/2"	28 1/2"	34 1/2"	40 1/2"	46 1/2"	52 1/2"	58 1/2"	64 1/2"	70 1/2"	76 1/2"	82 1/2"	88 1/2"	94 1/2"	100 1/2"	106 1/2"

Tube Face	C		D
	1 Row	2 Row	
12	2 1/32"	2 1/32"	4 1/32"
15	2 1/32"	2 7/32"	3 1/4"
18	2 1/32"	2 7/32"	2 1/2"
21	2 1/4"	2 1/4"	4 1/4"
24	2 1/4"	2 1/4"	3 1/32"

NOTE: STANDARD 2 ROW COIL IS FULL CIRCUIT.  
STANDARD 1 ROW COIL IS  $\frac{1}{2}$  CIRCUIT.  
INSTALL WITH CASING UP.  
HAND NOT REQUIRED - SEE NOTE ON END VIEW FOR A  
DRAIN FROM BOTTOM OF ROIN HEADINGS.  
COILS CONSTRUCTED FOR HORIZONTAL AIRFLOW ONLY.

FOLDOUT FRAME

**AEROFIN**  
**LYNCH®**

TITLE:  
TYPE "CH" CO  
1 & 2 Row — 1

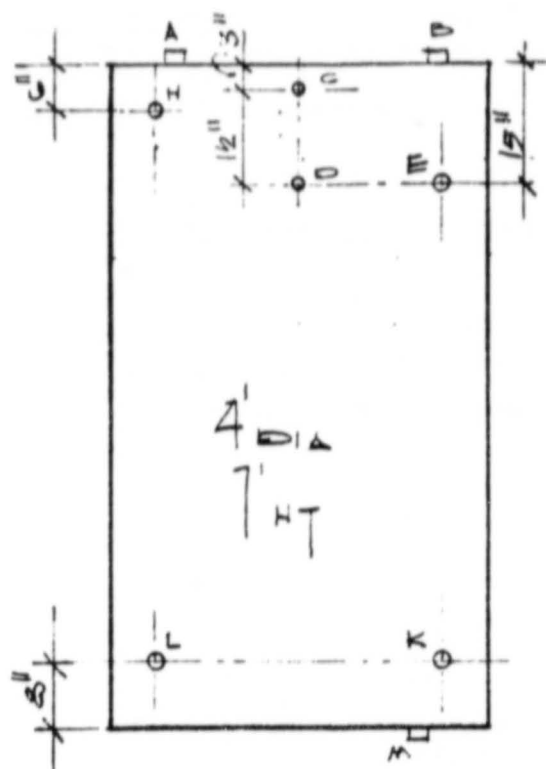
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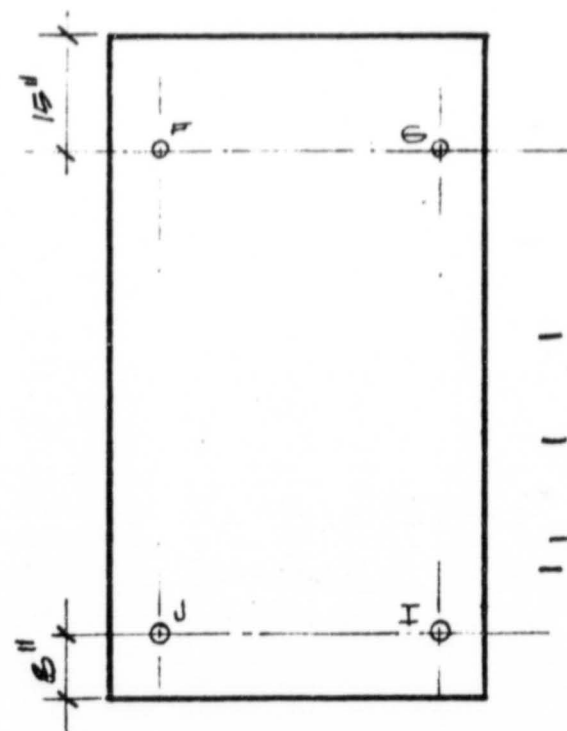
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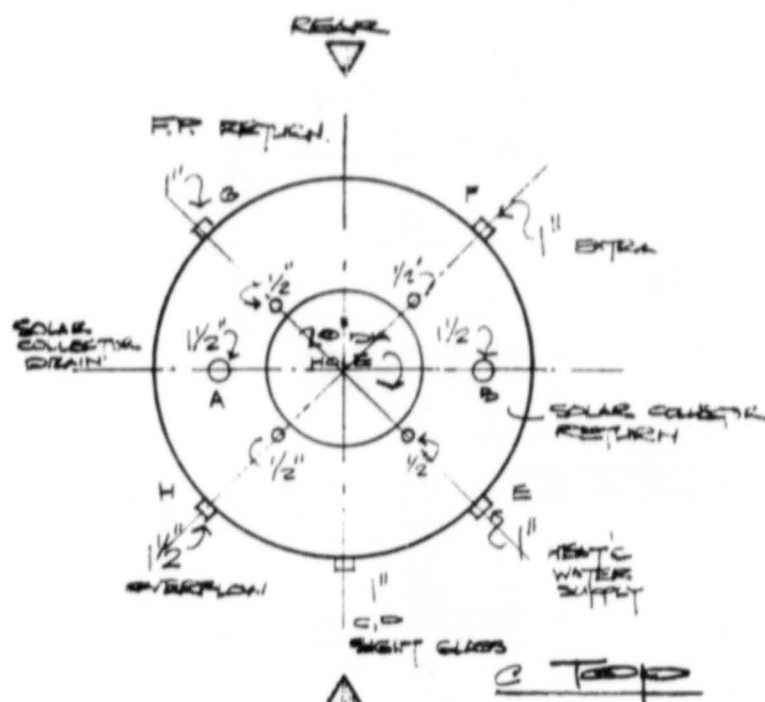
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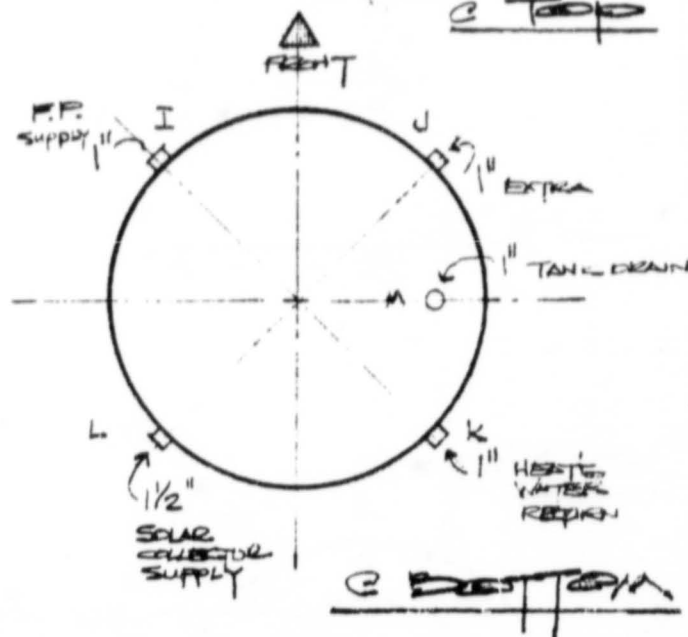
FRONT



REAR



TOP



BOTTOM

- ALL  $\frac{1}{2}$ " TO BE N.P.S. - LOCATE ON INSIDE OF TANK. ALL OTHER CONNECTIONS TO BE N.P.S. - LOCATE ON EXTERIOR.
- TANK SHALL HAVE 2 COATS OF ZINC CHROMATE ON INSIDE AND 1 COAT OF ZINC CHROMATE & 1 COAT OF RED LEAD ON EXTERIOR.
- PROVIDE 3" MTL LEG (FINISH AS EXTERIOR)
- PROVIDE 24" DIA CAP W/ 5/8" HOLE TO MATCH  $\frac{1}{2}$ " BOLT CONNECTION OUT OF TANK.

SOLAR STORAGE TANK  
RUST CONSTRUCTION CO.  
ALEX, VA.

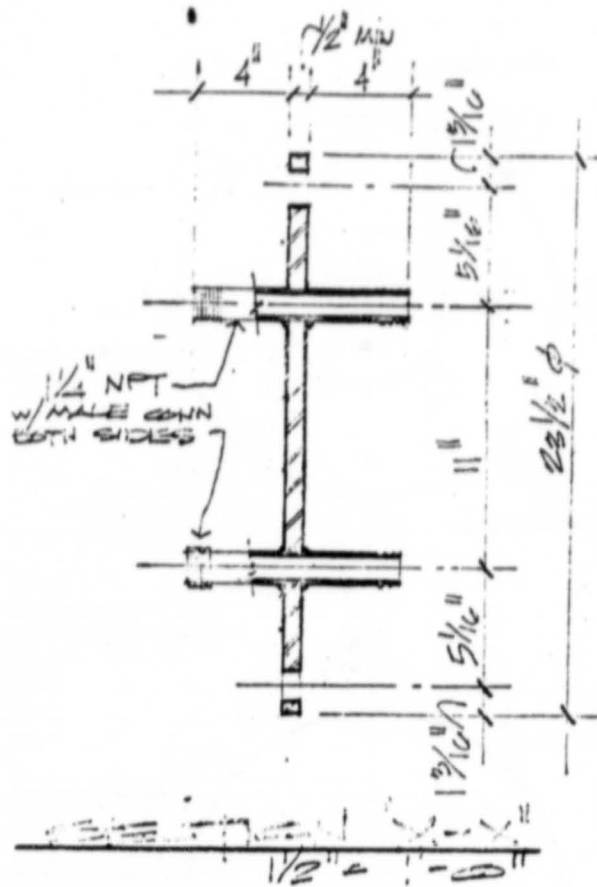
GEORGE H. LEE ARCHITECT WASHINGTON, D.C.

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ARLINGTON RESIDENT  
FALL & HAND BELLOWED  
ARLINGTON, VA

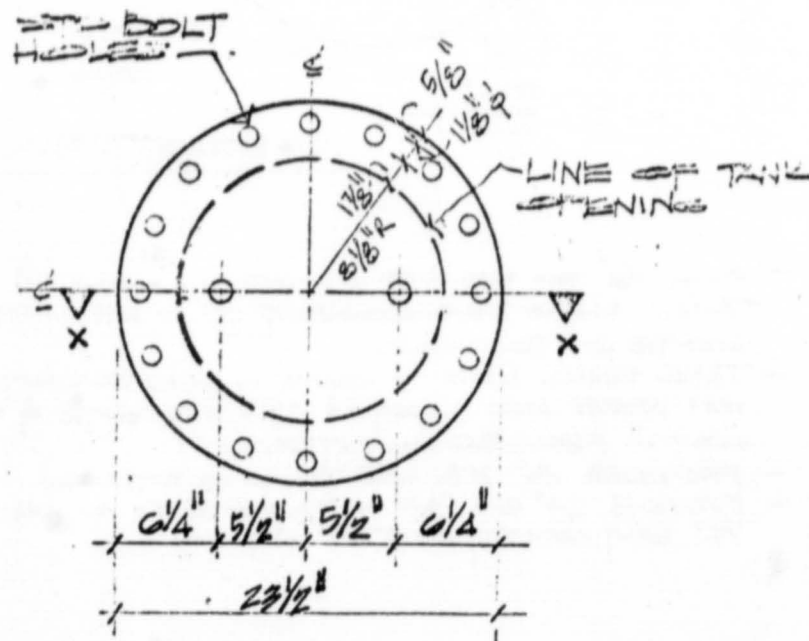
SOLE PHOTO H.E.  
COVER PLATE

THE R.F.T. SOLY CO.  
210 S. FOMPS ST.  
ALEX, VA 22304



### NOTES.

1. PROVIDE GASKET FOR COVER PLATE
2. PAINT SURFACES WITH W/CLD OXIDE PAINT (24 HRS)



ORIGINAL PAGE IS  
OF POOR QUALITY

george f. lee

architect

2035 thirteenth street nw, washington, d. c.  
(202) 462-7931

20009

# Honeywell

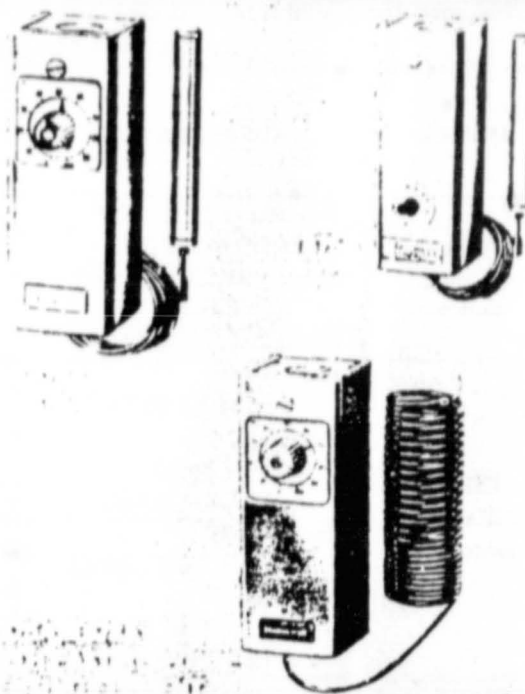
THE T675 AND T678 TEMPERATURE CONTROLLERS REGULATE THE TEMPERATURE OF AIR OR LIQUIDS IN DUCTS, PIPES, TANKS, AND BOILERS. TYPICAL USES INCLUDE CONTROL OF DAMPERS AND VALVES IN HEATING, COOLING, OR HEATING-COOLING SYSTEMS.

- ☐ T675A has 1 single-pole, double-throw (spdt) switch that breaks R-B and makes R-W at the set point on a temperature rise.
- ☐ T675B Manual Reset Low Limit has 1 single-pole, single-throw (spst) switch that breaks at the set point on a temperature fall, and requires manual resetting.
- ☐ T678A has 2 single-pole, double-throw (spdt) switches that operate in sequence. The right switch breaks R-B and makes R-W at the set point on a temperature rise. The left switch breaks R-B and makes R-W if the temperature continues to rise through the interstage differential.
- ☐ T675A models available with an adjustable differential.
- ☐ T675A and T678A have set point adjustment knob on front of case.
- ☐ Capillary tubing allows remote mounting of sensing element; models available with various lengths.
- ☐ T675A and T678A models available with a fast-response sensing element.
- ☐ Controller can be mounted in any position.
- ☐ Mounting accessories available for all applications.
- ☐ Ambient temperature compensated.
- ☐ Insert supplied with TRADELINE models replaces set point knob to discourage tampering.

G.S.  
REV. 10-80

Form No.  
60-2200-5

## TEMPERATURE CONTROLLERS



### T675A,B T678A

**epc**  
Energy Products Center

# SPECIFICATIONS

## IMPORTANT

THE SPECIFICATIONS GIVEN IN THIS PUBLICATION DO NOT INCLUDE NORMAL MANUFACTURING TOLERANCES. THEREFORE, THIS UNIT MAY NOT MATCH THE LISTED SPECIFICATIONS EXACTLY. ALSO, THIS PRODUCT IS TESTED AND CALIBRATED UNDER CLOSELY CONTROLLED CONDITIONS, AND SOME MINOR DIFFERENCES IN PERFORMANCE CAN BE EXPECTED IF THOSE CONDITIONS ARE CHANGED.

## TRADELINE MODELS

TRADELINE models are selected and packaged to provide ease of stocking, ease of handling, and maximum replacement value. TRADELINE model specifications are the same as those of standard models except as noted below.

### TRADELINE MODELS AVAILABLE:

T675A and T678A Temperature Controllers—see Table I for TRADELINE models available.

CAPILLARY: 5 ft [1.5 m] long, copper (except 1 T675A model with a 20 ft [6.1 m] capillary).

### TRADELINE FEATURES:

- All TRADELINE Models include tamper-resisting insert and 107324A Capillary Holder. (Models with fast-response sensing element include 131524A Capillary Holder.)
- TRADELINE models of T675A, T678A supplied with impact-resistant Norel covers.
- TRADELINE pack with cross reference and special instruction sheet.

TABLE I—TRADELINE MODELS AVAILABLE

MODEL	DIFFERENTIAL	OPERATING TEMPERATURE RANGE (SCALE RANGE)		MAXIMUM SAFE BULB TEMPERATURE	
		F	C	F	C
<b>T675A</b> <sup>a</sup> (1 spdt switch)	Adjustable 3 F to 10 F [1.7 C to 5.6 C]	0 to 100 <sup>a,b</sup>	-18 to + 38	125	52
	Adjustable 3.6 F to 12 F [2.0 C to 6.7 C]	160 to 260	71 to 127	280	138
	Fixed at 1 F [0.6 C]	55 to 175 <sup>a</sup>	13 to 79	200	93
<b>T678A</b> <sup>a</sup> (2 spdt switches)	Each switch: Fixed at 3 F [1.7 C]	0 to 100	-18 to + 38	125	52
	Interstage: Adj. 3 F to 10 F [1.7 C to 5.6 C]	55 to 175 <sup>a</sup>	13 to 79	200	93
	Each switch: Fixed at 3.6 F [2.0 C]	55 to 175 <sup>a</sup>	13 to 79	200	93
	Interstage: Adj. 3.6 F to 12 F [2.0 C to 6.7 C]				

<sup>a</sup>TRADELINE model also available with a fast-response sensing element, including a 131524A Capillary Holder.

<sup>b</sup>TRADELINE model also available with a 20 ft [6.1 m] copper capillary.

## ORDERING INFORMATION

WHEN PURCHASING REPLACEMENT AND MODERNIZATION PRODUCTS FROM YOUR TRADELINE WHOLESALE OR YOUR DISTRIBUTOR, REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING NUMBER, OR SPECIFY—

1. Order number; specify TRADELINE model, if desired.
2. Operating temperature range (scale range).
3. Standard sensing bulb or fast-response sensing element (if available).
4. Capillary length and material.
5. Fixed or adjustable differential on a T675A.
6. Differential range on adjustable T675A and T678A models.
7. Replacement parts, if desired.
8. Accessories, if desired.

IF YOU HAVE ADDITIONAL QUESTIONS, NEED FURTHER INFORMATION, OR WOULD LIKE TO COMMENT ON OUR PRODUCTS OR SERVICES, PLEASE WRITE OR PHONE:

1. YOUR LOCAL HONEYWELL RESIDENTIAL SALES OFFICE (CHECK WHITE PAGES OF YOUR PHONE DIRECTORY).
2. RESIDENTIAL GROUP CUSTOMER SERVICE  
HONEYWELL INC., 1885 DOUGLAS DRIVE NORTH  
MINNEAPOLIS, MINNESOTA 55422 (612) 542-7500

(IN CANADA—HONEYWELL CONTROLS LIMITED, 740 ELLESMERE ROAD, SCARBOROUGH, ONTARIO)  
INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.



## STANDARD MODELS

MODELS (also refer to Table II):

T675A Temperature Controller—spdt switching to make or break a circuit on a temperature change; fast response models operate approximately 4 times faster than standard models.

T675B Low Limit Temperature Controller—spst

switching to break a circuit on a temperature fall; must be manually reset.

T678A Temperature Controller—2 spdt switches operate 2 independent circuits in sequence; fast-response models operate approximately 4 times faster than standard models.

TABLE II—STANDARD MODELS AVAILABLE

MODEL	SNAP-ACTING SWITCHES	DIFFERENTIAL <sup>a</sup>	OPERATING TEMPERATURE RANGE (SCALE RANGE) <sup>c</sup>		MAXIMUM SAFE BULB TEMPERATURE	
			F	C	F	C
T675A *	one spdt	Adjustable 3 F to 10 F [1.7 to 5.6 C]	0 to 100	-18 to + 38	125	52
			160 to 260	71 to 127	280	138
		Adjustable 3.6 F to 12 F [2.0 to 6.7 C]	55 to 175	13 to 79	200	93
			0 to 100	-18 to + 38	125	52
		Fixed at 1 F [0.6 C]	55 to 175 <sup>d</sup>	13 to 79	200	93
			160 to 260	71 to 127	280	138
T675B	one spst	Manual reset <sup>b</sup>	30 to 50 <sup>e</sup>	-1 to + 10	125	52
T678A *	two spdt	Each switch: Fixed at 3 F [1.7 C] Interstage: Adjustable 3 F to 10 F [1.7 C to 5.6 C]	0 to 100	-18 to + 38	125	52
			160 to 260	71 to 127	280	138
		Each switch: Fixed at 3.6 F [2.0 C] Interstage: Adjustable 3.6 F to 12 F [2.0 C to 6.7 C]	0 to 100 <sup>f</sup>	-18 to + 38	125	52
			55 to 175	13 to 79	200	93

<sup>a</sup>All differentials are subtractive except for the T675B (which has manual reset) and the interstage differential on T678A models.

<sup>b</sup>Temperature should rise 10 F [5.6 C] above the set point before resetting.

<sup>c</sup>Celsius scale plates available. See Accessories.

<sup>d</sup>Model available with a fast-response sensing element, including a 131524A Capillary Holder.

<sup>e</sup>Factory-set and locked at 37 F [3 C].

<sup>f</sup>Sensing element is a 12 ft [3.7 m] averaging element on the end of a 10 ft [3.0 m] copper capillary.

### ELECTRICAL RATINGS:

T675A models with adjustable differential and T678A:

	120 Vac	240 Vac	277 Vac
Full Load	8.0	5.1	4.2
Locked Rotor	48.0	30.6	25.2
Pilot Duty	125 VA	125 VA	125 VA

T675A models with fixed differential—125 VA at 120/208/240/277 Vac.

T675B—125 VA pilot duty up to 277 Vac.

T678A—maximum connected load = 2000 VA.

OPERATING TEMPERATURE RANGE (SCALE RANGE): See Table II.

DIFFERENTIAL: See Table II.

### ADJUSTMENTS:

Set Point (Operating Temperature):

T675A and T678A—adjustment knob on dial on front of controller.

T675B—screwdriver slot in center of dial (cover must be removed).

Differential (cover must be removed):

T675A models with adjustable differential—adjustment dial on snap acting switch.

T678A interstage differential—star wheel on left side of chassis.

(continued on page 4)

**MAXIMUM SAFE BULB TEMPERATURE:** See Table II.  
**TEMPERATURE SENSING ELEMENT:** Standard element is a liquid-filled, remote bulb. Some models are available with a fast-response, liquid-filled, coiled capillary element which reduces response time to approximately 1/4 that of the standard bulb.

**SENSING BULB SIZE:**

Length—4-3/16 in. [106.4 mm];  
 Diameter—1/2 in. [12.7 mm].

**MAXIMUM SENSING BULB PRESSURE:** 50 psi [344.7 kPa] for direct immersion.

**CAPILLARY LENGTH AND MATERIAL:**

T675A and T678A standard models—5 ft [1.5 m] copper, or 20 ft [6.1 m] copper, monel, or stainless steel.

T675A and T678A fast-response models—5 ft [1.5 m] copper capillary with a coiled sensing element on the end; sensing element is coiled 1/8 in. [3.2 mm] tubing, 1-1/2 in. [38.1 mm] diameter x 5 in. [127 mm] long. The coil may be stretched to approximately 10 in. [254 mm].

T675B—10 ft [3.0 m] copper.

**CAPILLARY HOLDER:** 107324A included with TR, DELINE models (except fast-response models). 131524A included with all fast-response models.

**WIRING KNOCKOUTS:** Two, 7/8 in. [22.2 mm] diameter knockouts for 1/2 in. conduit (1 in the top and 1 in the bottom).

**CONTROLLER MOUNTING:** Any position; 3 screws through slotted holes in back of case (Fig. 1).

**SENSING BULB MOUNTING:**

In air ducts—capillary holder (Figs. 2 and 3).

In boilers or storage tanks—immersion well (Fig. 4) or capillary compression fitting (Fig. 5).

**DIMENSIONS:** See Fig. 1.

**APPROVALS:**

**UNDERWRITERS LABORATORIES INC. LISTED:**  
 T675A and T678A—File No. E4436, Vol. 4; Guide No. XAPX.

T675B—File No. SA481, Vol. 3; Guide No. SDFY.

**CANADIAN STANDARDS ASSOCIATION CERTIFIED** (120 V, 240 V, and some 208 V models only): T675A and T678A—File No. LR1620, Guide No. 400-E-0.

**REPLACEMENT PART:**

1. 131524A Capillary Holder, for mounting a fast-response sensing element in an air duct.

**ACCESSORIES:**

1. 107324A Capillary Holder—for mounting a sensing bulb in an air duct; 8-3/8 in. [212.7 mm] long.

2. 311266D Duct Bulb Holder.

3. Immersion Well Assembly—to protect sensing bulb from mechanical or chemical damage when mounting in a boiler or storage tank; copper; 4-3/4 in. [120.7 mm] insertion length; includes 112721 Tube Clip for clamping capillary tube to immersion well—

—112622AA, 1/2-14 NPT external threads on spud.

—112630AA, 3/4-14 NPT external threads on spud.

4. Capillary Compression Fitting—to provide seal-off when mounting sensing bulb directly in a boiler or storage tank; brass; 5/8 in. [15.9 mm] thread length—

—104484A, 1/2-14 NPT external threads on spud.

—104484B, 3/4-14 NPT external threads on spud.

5. 105900 T-strap—for clamping sensing bulb to a pipe or similar mount.

6. 7640HY Bag Assembly—with standoff bracket for mounting the controller to an insulated duct.

7. Q615A Splash-proof Enclosure.

8. 34886A Sun Shield.

9. 801534 Calibration Wrench.

10. 194899 Tamper-resisting Insert Button to conceal set point.

11. Celsius Salesplates for T675.

—194486D: minus 15 C to plus 35 C replaces 0 F to 100 F scaleplate.

—194486H: 15 C to 75 C replaces 55 F to 175 F scaleplate.

—194486F: 75 C to 125 C replaces 160 F to 260 F scaleplate.

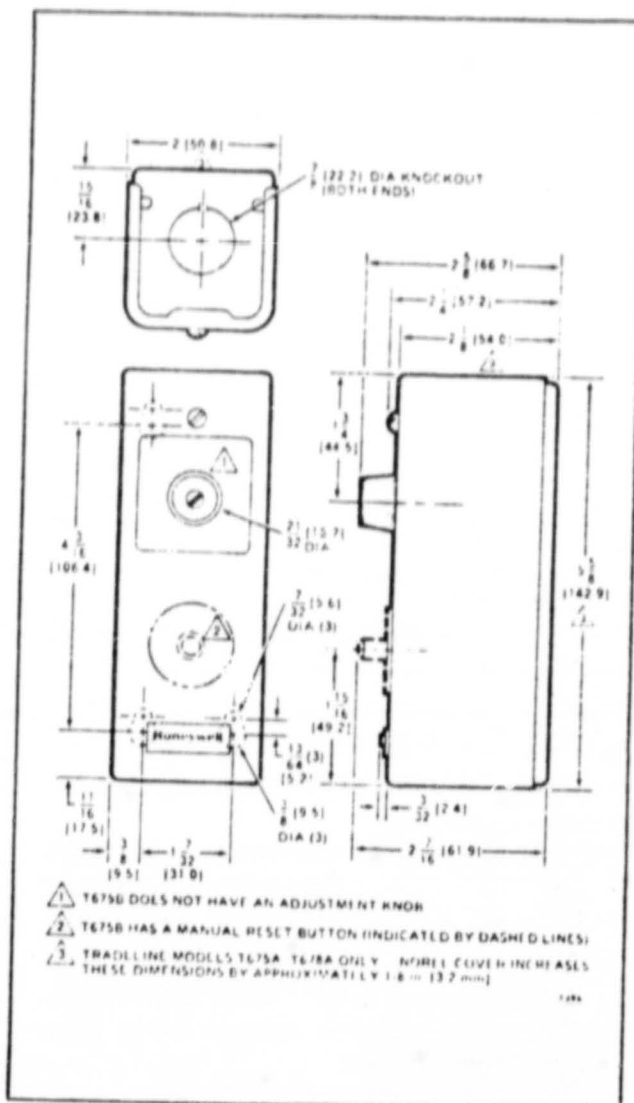


FIG. 1—DIMENSIONS OF THE T675 AND T678 TEMPERATURE CONTROLLER, IN in. [mm IN BRACKETS].

# INSTALLATION

## WHEN INSTALLING THIS PRODUCT...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.

## CAUTION

Disconnect power supply before beginning installation to prevent electrical shock and equipment damage.

## LOCATION AND MOUNTING

The controller may be installed in any convenient position. Mount it with 3 screws through the slotted holes in the back of the case (Fig. 1). Be sure to consider the length of the capillary before mounting the controller.

Install the sensing element where it is exposed to the average temperature of the controlled medium. The sensing bulb may be directly immersed or mounted in a well. T675A or T678A fast-response models must use the capillary holder furnished with the device (Fig. 2). The remote sensing bulb of standard models should be held in place with a capillary holder, immersion well, or compression fitting (Figs. 3-5). Sharp bends or kinks in the capillary tubing affect the efficiency of the controller and must be avoided. Excess capillary should be carefully coiled and left directly beneath the controller.

**NOTE:** When pressure fittings are used in areas of vibration, such as pipe lines, the bulb must be adequately supported.

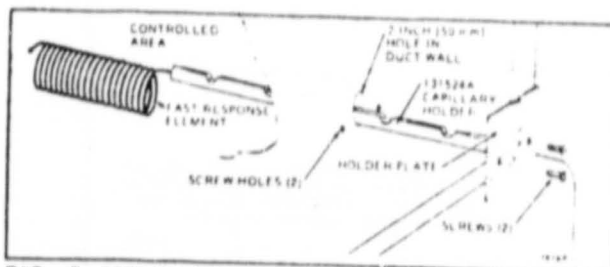


FIG. 2—MOUNTING A FAST-RESPONSE ELEMENT IN AN AIR DUCT.

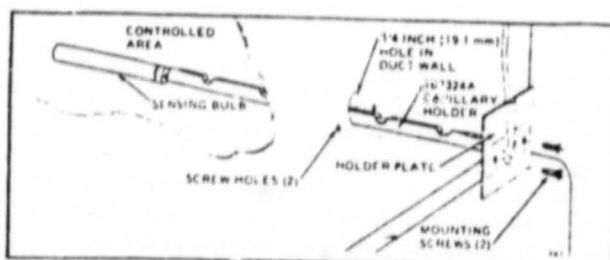


FIG. 3—MOUNTING THE SENSING BULB AND CAPILLARY HOLDER IN AN AIR DUCT.

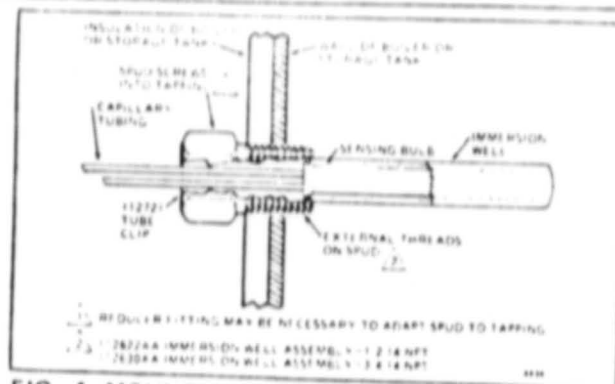


FIG. 4—MOUNTING THE SENSING BULB IN AN IMMERSION WELL.

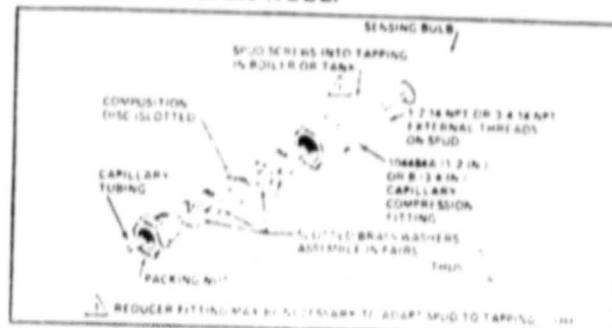


FIG. 5—MOUNTING THE SENSING BULB USING A CAPILLARY COMPRESSION FITTING.

## WIRING

Disconnect the power supply before making wiring connections to prevent electrical shock and equipment damage. All wiring must comply with applicable electrical codes, ordinances, and regulations. If using the controller with a flame safeguard control, use moisture-resistant No. 14 wire suitable for at least 167 F [75 C] for a primary control (such as an RA890), or for at least 194 F [90 C] for a programming control (such as an R4140). For high temperature installations, use moisture-resistant No. 14 wire selected for a temperature rating above the maximum operating temperature.

Two knockouts for 1/2 in. conduit are provided—one in the top and one in the bottom of the case. Follow the wiring instructions furnished with the heating or cooling system. Fig. 6 shows the switching action.

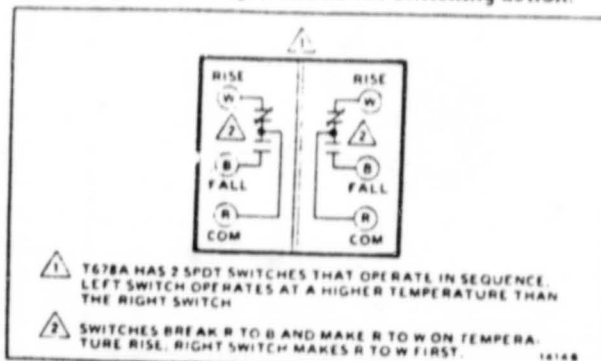


FIG. 6—T678A SWITCHING. T675A HAS ONE spdt SWITCH. T675B HAS ONE spst SWITCH (opens on temp. fall).



# OPERATION

## T675A

As the temperature of the controlled medium falls below the set point less differential, the T675A switch makes terminals R to B and energizes a normally closed solenoid valve to provide heat. In cooling applications, the T675A makes terminals R to W as the temperature rises above the set point, energizing cooling equipment. Fig. 7 shows the operation of the T675A. Fig. 8 shows the location of the adjustment dial on models with an adjustable differential.

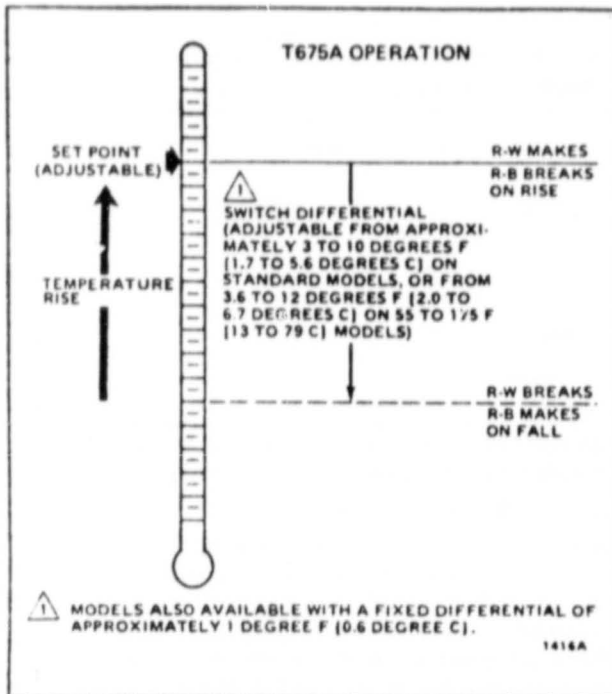


FIG. 7—OPERATION OF THE T675A.

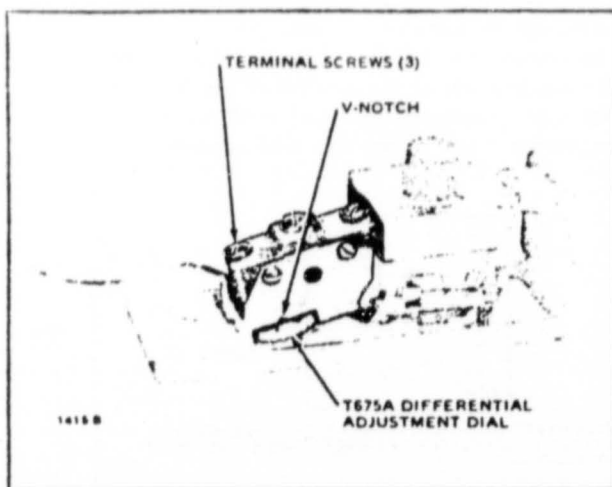


FIG. 8—LOCATION OF THE ADJUSTMENT DIAL ON T675A MODELS WITH AN ADJUSTABLE DIFFERENTIAL.

## FREEZE-UP PROTECTION

When using the T675A (auto-recycling) for freeze-up protection, the recommended set point is 38 F [3.3 C] plus the switch differential.

Example: Set point of 38 F [3.3 C] plus 1 F [0.6 C] (fixed differential model) equals an actual set point of 39 F [3.9 C].

Example: Set point of 38 F [3.3 C] plus 3 F [1.7 C] (adjustable differential model) equals an actual set point of 41 F [5 C].

This provides an adequate safety factor for freeze-up protection.

NOTE: The T675B is a manual reset device specifically designed for freeze-up protection.

## T675B

Used as a low limit controller, the T675B interrupts the operation of equipment if the temperature of the controlled medium falls below the set point. The device is reset manually after a rise in temperature of approximately 10 F [5.6 C]; push in the manual reset button on the front of the case. The operation of the T675B is shown graphically in Fig. 9.

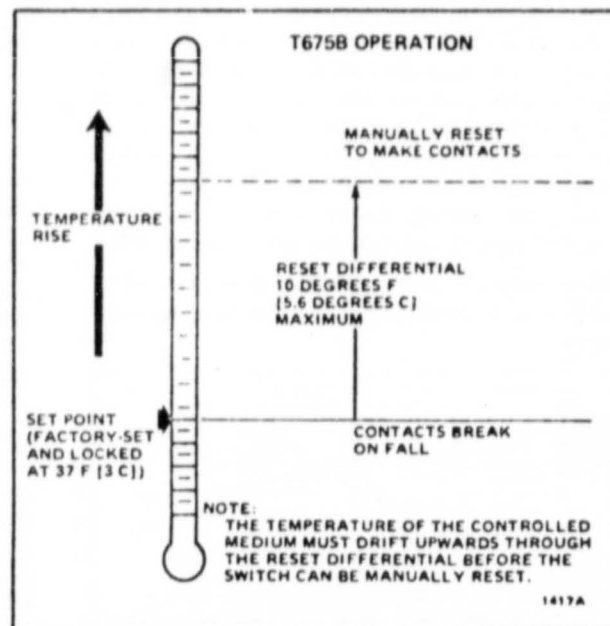


FIG. 9—OPERATION OF THE T675B.

## T678A

When the temperature at the sensing element rises above the set point of the controller, the switch on the right makes R-W. Should the temperature continue to rise through the preselected interstage differential of the controller, the switch on the left will make R-W.

Conversely, on a temperature fall, the switch on the left makes R-B, providing first step switching. If the temperature continues to fall, the switch on the right makes R-B to provide sequencing of equipment.

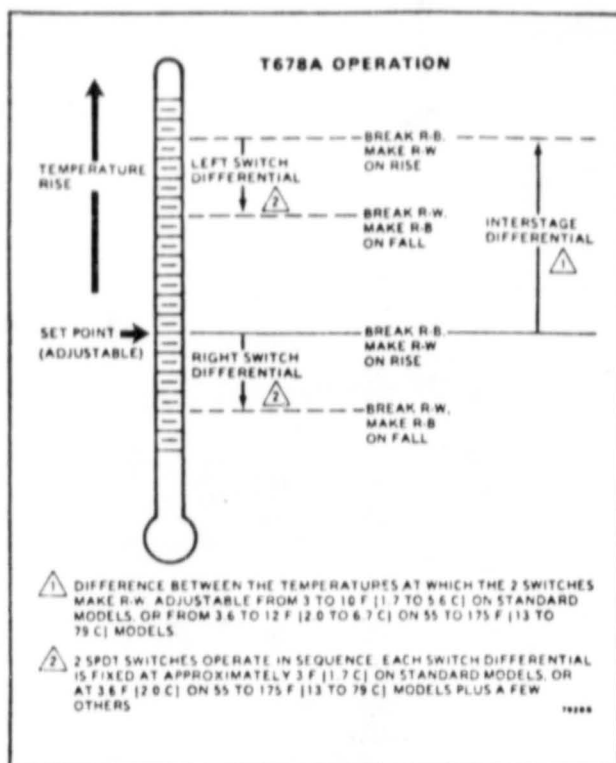


FIG. 10—OPERATION OF THE T678A.

The T678A Temperature Controller has an adjustable interstage differential. The set point adjustment knob determines the temperature at which the right switch operates. The left switch can be adjusted to operate from 3 F to 10 F [1.7 C to 5.6 C] (or 3.6 F to 12 F [2.0 C to 6.7 C] on some models) above the point of operation of the right switch. An illustration depicting the operation of the T678A is shown in Fig. 10. The interstage differential is adjusted by turning the star wheel with a narrow screwdriver inserted into the rectangular hole in the chassis (Fig. 11).

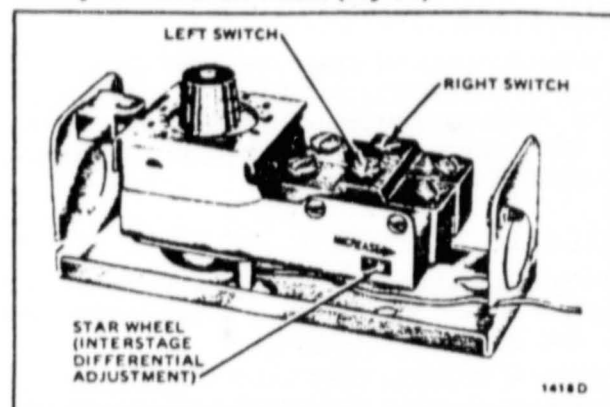


FIG. 11—INTERSTAGE DIFFERENTIAL ADJUSTMENT ON A T678A.

## CALIBRATION AND CHECKOUT

All controllers are carefully tested and calibrated at the factory under controlled conditions. If the controller is not operating at a temperature corresponding to the scale setting and differential setting, check to see that the sensing bulb senses the average temperature of the medium controlled. If the temperature of the controlled medium is changing rapidly, the differential will appear wider than its setting.

For calibration, an accurate temperature reading of the controlled medium must be taken. Place an accurate thermometer near the sensing bulb, or refer to a thermometer that has been installed as part of the system. If the sensing bulb is installed in an inaccessible area, or if the controlled medium is unstable, the bulb should be removed and placed in a controlled bath for accurate calibration.

### T675A

These controllers are calibrated so that the dial setting, indicated by the pointer on the adjustment knob, is the point at which the R-W switch contacts make on a temperature rise. Measure the temperature at the bulb. Rotate the adjustment knob counterclockwise from the top of the scale, simulating a temperature rise, until the R-W switch contacts make. Note the dial reading. If it differs from the bulb temperature, calibrate the dial as follows:

1. Determine the number of degrees difference between the bulb temperature and the dial reading at which the R-W switch contacts make.

2. Remove the adjustment knob and slip the fingers of the calibration wrench (accessory, Part No. 801534)

into the slots of the dial. Rotate the dial until the fingers of the wrench drop into the slots of the calibration nut under the dial. Note the dial indication at this point. Turn the dial and the calibration nut up or down scale the number of degrees that the bulb temperature differs from the point at which the contacts make (determined in step 1). For example, move the dial from 45 to 65 if the dial reading in step 1 was 45 degrees and the bulb temperature was 65 degrees.

3. Check the calibration adjustment by moving the adjustment knob up and down the scale while listening for the contacts to make and break. If the dial is still out of calibration, repeat the calibration procedure.

### T675B

NOTE: The cover must be removed to see the dial. All T675B models have been factory-set and locked at 37 F [3 C].

These controllers are calibrated so that the dial setting, indicated by the fixed pointer at the top of the dial, is the point at which the switch contacts break on temperature fall.

Measure the temperature at the bulb. Remove the cover of the controller. Loosen the locking screw. Insert a screwdriver in the slot in the center of the dial. Start with the dial at the bottom of the scale, and rotate the dial counterclockwise to simulate a temperature fall until the switch contacts break. Note the dial reading. If it differs from the bulb temperature, follow the calibration procedure outlined for the T675A. Tighten the locking screw and replace the cover.



PENN

CONTROLS

PENN CONTROLS INC.

PRODUCT INFORMATION

P80

3583-B

3583 A

## series P80

### PRESSURE CONTROLS

(Floating and Proportional)

#### APPLICATION

For accurate control of steam and liquid pressures in heating, air conditioning and industrial process applications. Normally used to position Penn Series M80, M81 Motor Actuators for the control of air dampers, valves and similar devices.

#### FEATURES

1. Heavy duty enclosure which is splash-proof and dust-tight is entirely suitable for industrial installations as well as for outdoor mounting.
2. Adjustable throttling range standard on all controls. This feature enables "on the job" selection of the right throttling range to provide for stable control and minimum control point variation.
3. Front viewing control point and throttling range scales simplify setting and checking of these vital factors.
4. Large coded screw type terminals accessible from front of control for easier installation.

#### GENERAL DESCRIPTION

On these pressure controllers a pressure increase produces a positive pressure on the sensitive bellows at the instrument case. The bellows in turn directly positions precision potentiometers or floating contacts within the instrument through a knife-edge pivot mechanism.

Type P80BAA Pressure Controls incorporate a single-pole, double-throw non-snap acting switch action for floating control of a reversible (Series M81) Motor Actuator. This series of controls should be used only on applications where the rate of pressure change is very slow or where very small changes in Motor Actuator position result in almost immediate corrections in the controlled pressure. The use of this series of controls on applications which do not meet these requirements will normally result in unstable control and wide pressure variations.

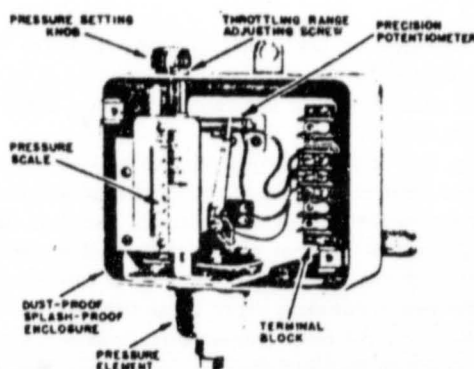


Fig. 2 — Interior view of Series P80 Pressure Control.

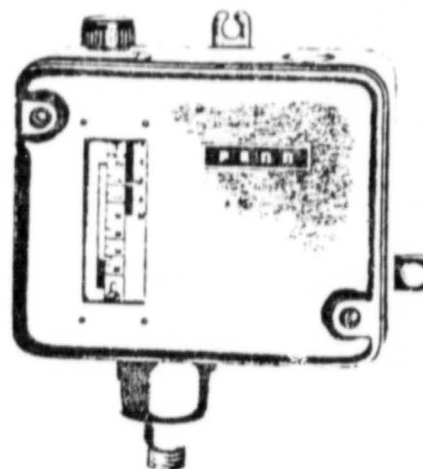


Fig. 1 — Exterior view of Series P80 Pressure Control.

ator position result in almost immediate corrections in the controlled pressure. The use of this series of controls on applications which do not meet these requirements will normally result in unstable control and wide pressure variations.

Type P80ABA Pressure Controls incorporate a precision-wound potentiometer that is positioned in direct relation to the pressure variations which occur. The potentiometer thus produces a variable voltage signal which is indicative of the sensed pressure. The signal is used to directly position a Series M80 Motor Actuator which provides pressure correction by operation of dampers, valves, etc. Common usage has the variable voltage signal positioning a voltage sensitive relay located within the Motor Actuator. The relay in turn runs the motor in either of two directions to correct for the pressure variations. A built-in Motor Actuator potentiometer, which is positioned in direct relation to the actuator movement, produces a voltage signal in direct opposition to the signal from the pressure controller and thus will rebalance the control relay and cause the Motor Actuator to stop before a pressure change has actually occurred. This anticipating action, commonly referred to as proportional control, minimizes pressure over and under shoots as well as assuring Motor Actuator stability.

Type P80ACA Pressure Controls are similar to the Type P80ABA except they have two potentiometers operating simultaneously. These controls are used when two Series M80 Motor Actuators are to be positioned together. A typical application would be the control of actuators positioning a large air damper on an air-cooled condenser.

## MISCELLANEOUS SPECIFICATIONS

**Electrical Rating:** Type P80BAA — 2.0 Amps. at 24 V. A.C. only. All others low voltage, A.C. only and use 135 ohm, two watt potentiometers as standard.

**Throttling Range:** Adjustable. Minimum dependent on scale range. Refer to Specification Table for complete information.

**Pressure Element:** Brass with 1/4" NPT male fitting except, 30 to 500 psig range has a 36" capillary tube with 1/4" flare nut; 3 to 20 psig range has a 1/8" MPT fitting.

**Finish:** Gray baked enamel.

**Scale Range:** Refer to Specification Table for complete information.

## OPTIONAL CONSTRUCTIONS

Pressure controls are available on special order with any of the following variations:

1. Capillary type elements with 6 feet of copper capillary and a 1/4" flare connector.
2. Stainless steel elements for corrosive gases and fluids (available in 20" Hg. to 80 psig and 25 to 275 psig ranges only).
3. 330 ohm potentiometer available for use with Model R21AA-3 Signal Center.

## ORDERING INFORMATION

To order, specify:

1. Pressure Control Type Number.
2. Scale range.
3. Optional variations, if required.

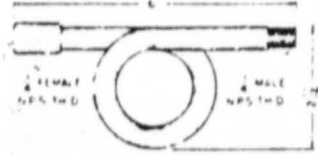
For example, one Type P80ABA Pressure Control with 0 - 40 psig scale range.

SPECIFICATION TABLE

New Type Number	Control Mode	Scale Range PSIG	Throttling Range PSI <sup>*</sup>		Maximum Element Pressure
			Min.	Max.	
P80BAA	Floating SPDT Contacts	20" Hg. to 80	7	20	325
		3 to 20	2.5	7.5	30
P80ABA	One Potentiometer	0 to 40	2.5	14.5	60
		15 to 150	7	28	180
P80ACA	Two Potentiometers in Unison	25 to 275	10	40	325
		30 to 500	25	100	525

<sup>\*</sup> Indicated throttling ranges do not apply to Type P80BAA controls; this series has a differential equal to approximately 1/10 of the indicated throttling range. For example, a P80BAA control with a 0 to 40 psig scale range has a minimum differential of 0.25 psi (1/10 of 2.5 psi) and a maximum of 1.45 psi (1/10 of 14.5 psi).

**STEAM TRAP**



Recommended to be used on all steam applications  
Specify Part No. J-923

## LOCATING AND MOUNTING

Mount in any position where the controller will be exposed to the representative pressure of the system. Always use, sparingly, an approved pipe sealing compound (such as white lead) on the threads to insure a snug installation (except flared connector types).

On steam applications a steam trap (siphon) should always be installed between the controller and the boiler to prevent corrosive vapors or scale (from boiler treatment compounds) from corroding the bellows. When it is desirable to mount the controller next to the steam pressure gage, remove the gage and install a steam trap (siphon) in its place. To the free end of the steam trap install a pipe tee and to the two open ends of the tee install the pressure gage and pressure controller respectively.

Capillary type sensing elements are available when it is necessary to mount the controller case remotely (excessive vibration, panel mounted, etc.). When used on steam applications, coil a length of the capillary to form the required steam trap and pitch the capillary to drain all condensate back to the boiler. If controller case is to be mounted below the sensing element connection point, fill the capillary with clean water. Under the last condition and on water pressure control applications, the controller set point should be adjusted 1.0 PSI higher for each 2.3 feet of vertical distance between controller and point of element connection. This is to compensate for the water pressure "head" developed in the capillary.



## WIRING

Make all connections in accordance with local ordinances and national codes. Use #18 wire or larger for all connections to the pressure controller. Number 14 wire should be used on runs over 500 feet long. When wiring in conduit with other wires, controller wires must have insulation equal to the other conductors in the conduit run. All splices should be made in junction boxes utilizing approved solderless connectors or by soldering and then taping the connection.

All connections to the controller should be made to the large, numbered, screw-type terminals located directly under the front cover of the enclosure. One-half inch conduit openings are provided in top, bottom and right side of housing. Refer to the last page of this bulletin for typical external and internal wiring diagrams.

## ADJUSTMENTS

**Pressure Setting:** Turn pressure setting knob on top of case until scale indicator is at the pressure to be maintained.

**Throttling Range Adjustment:** On Type P80ABA and P80ACA controllers the throttling range adjusting screw is located directly in front of the pressure setting knob on top of the instrument case. Turning screw counter-clockwise reduces the instrument's throttling range; turning clockwise increases throttling range. Minimum and maximum throttling ranges for controllers with various scale ranges are given in the Specification Table. Intermediate throttling range settings result in proportionate changes in throttling range.

When making this adjustment, it is suggested that the setting first be made at the minimum position. If this setting does not provide stable system operation, the adjusting screw should be slowly turned clockwise until a point is reached where stable operation occurs. Stable operation can normally be recognized by viewing the controlled motor actuator; if it assumes a new position on a change in control point setting and stays there, stable operation has been obtained. However, if the actuator continues to move, first in one direction and then the other, unstable operation is apparent and the throttling range should be increased until this condition is eliminated. It is important to use the lowest throttling range setting that provides stable operation, for any increase in throttling range results in a greater pressure variance from controller set point at minimum and maximum load conditions.

On Type P80BAA controllers, the same adjusting screw is used to change the differential of the instrument. The differential is the amount of pressure change at the sensing element which is necessary to move the common of the SPDT non-snap acting switch mechanism from just making one contact to just making the

other. Normally the minimum differential setting is acceptable, but occasionally it may be necessary to increase the differential if the motor actuator appears to be repositioning excessively.

## CALIBRATION

If for any reason it is necessary to recalibrate the controller in the field, proceed as follows:

1. Determine the actual pressure at the sensing element. Make certain that the media pressure is remaining reasonably constant at the time of calibration.
2. Turn pressure setting knob until:
  - a. (Type P80BAA) common of contact mechanism is floating between the two contacts.
  - b. (Type P80ABA and P80ACA) potentiometer wiper is at the right end of active windings of potentiometer.
3. Loosen pressure scale screws and slide scale plate up or down until indicator is opposite the pressure marking on the scale that corresponds to the measured pressure at the sensing element. Retighten pressure scale screws.

## MAINTENANCE

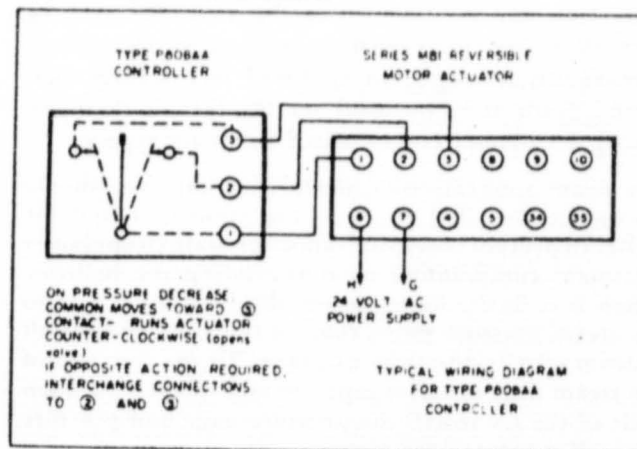
No periodic maintenance of any kind is necessary on these controllers.

If necessary to order replacement parts, always give as complete a description of the part as possible along with the complete Model Number of the pressure controller. For example: — One pressure sensing element for a Model P80ABA-1 Pressure Controller.

## TYPICAL INTERNAL AND EXTERNAL WIRING

(Internal wiring shown in dotted lines)

### Type P80BAA Controllers:



SERIES MBO PROPORTIONAL  
MOTOR ACTUATOR (with relay)

TYPE PBQABA  
CONTROLLER

24 VOLT & C  
POWER SUPPLY

ON PRESSURE DECREASE:  
WIPER MOVES TOWARDS END  
(3) - RUNS ACTUATOR COUNTER-  
CLOCKWISE (opens valve)  
IF OPPOSITE ACTION REQUIRED,  
INTERCHANGE CONNECTIONS  
TO (1) AND (3)

The diagram illustrates the wiring for a Type Progam Controller. It features two 'SERIES 1880 PROPORTIONAL MOTOR ACTUATOR (with relay)' units and a central 'TYPE PROGAM CONTROLLER' unit. Each actuator has a 24 VOLT A.C. POWER SUPPLY connected to terminals H and G. The controller unit has two sets of terminals labeled 8, 9, and 10. Wires connect the actuators to these terminals, and the controller's internal components, including relays and resistors, are shown within its housing.

**SERIES 1880 PROPORTIONAL MOTOR ACTUATOR (with relay)**

24 VOLT A.C. POWER SUPPLY

**TYPE PROGAM CONTROLLER**

ON PRESSURE DECREASE: CONNECTIONS OF BOTH POTENTIOMETERS MOVE IN UNISON TOWARD ENDS 8 AND 10 - RUNS ACTUATORS COUNTER-CLOCKWISE (steps reverse)

IF OPPOSITE ACTION REQUIRED FOR EITHER ACTUATOR OR BOTH, INTERCHANGE CONNECTIONS TO 8 AND 10 and/or 9 AND 10

**SERIES 1880 PROPORTIONAL MOTOR ACTUATOR (with relay)**

24 VOLT A.C. POWER SUPPLY

**TYPICAL WIRING DIAGRAM FOR TYPE PROGAM CONTROLLER**

[illegible]

**PENN** CONTROLS, INC.

[illegible]

**AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES**



Johnson Controls, Inc.  
 Control Products Division

2221 Camden Court  
 Oak Brook, IL 60521

## Series A41 Wire Wound Temperature Sensors For Duct, Immersion and Outdoor Sensing

### Application

These nickel wire wound sensors are used with Penn electronic controllers that require wire wound sensor inputs, such as the Series R41 MIZER, R48 MINI-MIZER or R94 controller.

### Features

- Highly sensitive nickel wire sensing element.
- Solid state components.
- Easy to install and wire.

### Specifications

Type Number		1000 ohms, Immersion, NEMA Type 1 Enclosure, 6" Wire Leads
	<b>A41FA</b>	1000 ohms, Duct, Plug Connector
	<b>A41FT</b>	50 ohms, Duct, Zone Discharge, 20:1 Authority, Plug Connector
	<b>A41GA</b>	1000 ohms, Duct, 6" Wire Leads
	<b>A41GT</b>	50 ohms, Duct, Zone Discharge, 20:1 Authority, 6" Wire Leads
	<b>A41HA</b>	1000 ohms, Duct, NEMA Type 1 Enclosure, 6" Wire Leads
	<b>A41QA</b>	1000 ohms, Outdoor, Weathertight Condulet, 6" Wire Leads
Insertion Depth of Sensors	<b>A41WA</b>	1000 ohms, High Temperature to 350 F (177 C), Wire Leads
	Duct	6" (152 mm)
	Immersion	Approx. 3' (76 mm)
Material	Duct	Aluminum Support and Mounting Plate
	Immersion	Steel Handi-box and Packing Nut Assembly, 1/2" NPT Brass Bulb Well
	Outdoor	Aluminum Condulet Fitting with Gasketed Cover
Operating Temperature Range		- 40 to 240 F ( - 40 to 116 C) Unless Otherwise Specified
Reference Resistance		50 ohms at 70 F (21 C) for Types A41FT and A41GT, 1000 ohms at 70 F (21 C) all others
Resistance Tolerance	1000 ohms	- 1% at 70 F (21 C)
	50 ohms	- 1 ohm at 70 F (21 C)
Sensing Element		Nickel Wire Wound, Encapsulated
Shipping Weight (Individual Pack)	<b>A41BA</b>	8 lb. ( 36 kg)
	<b>A41GA, A41FA, A41FT, A41GT</b>	5 lb. ( 23 kg)
	<b>A41HA</b>	1.0 lb. ( 45 kg)
	<b>A41QA</b>	1.1 lbs. ( 51 kg)
	<b>A41WA</b>	06 lb. ( 027 kg)
Temperature Coefficient	1000 ohms	Positive Resistance Change Approximately 3 ohms Per Degree Fahrenheit (5.4 ohms Per Degree Celsius)
	50 ohms	Positive Resistance Change Approximately 3:Authority ohms Per Degree Fahrenheit (5.4:Authority ohms Per Degree Celsius) Example 3/20:1 - 15 ohms Per Degree Fahrenheit

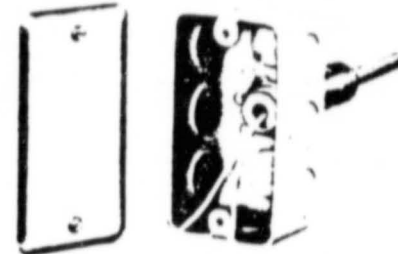


Fig. 1—Type A41BA Immersion Sensor.

—Shielded wire not normally required.

### General Description

The Series A41 sensors are available for duct, immersion and outdoor sensing applications.

The duct sensor mounts directly to the flat surface of the duct with sheet metal screws. It has a rigid aluminum support which is inserted into the duct and supports the nickel wire



Fig. 2—Type A41GA Duct Sensor less enclosure.



Fig. 3—Type A41HA Duct Sensor with NEMA Type 1 enclosure.



Johnson Controls, Inc.  
Penn Division  
2221 Camden Court  
Oak Brook, IL 60521

## Series R34D Solid State Differential Temperature Controller—For Use With Nickel Wire Wound Sensors

### Application

These differential temperature controllers are for use on applications where it is desirable to provide on-off control by the difference between two sensed temperatures. Controllers are supplied with calibrated adjustments.

Typical applications include:

- Solar heating systems
- Fruit and vegetable storage spaces
- Machine tool equipment

These controllers provide a SPDT relay output that is switched according to the temperature differential measured by two Penn

nickel wire resistance sensors. Sensor No. 1 is located in the lower temperature area and sensor No. 2 is located in the higher temperature being sensed.

### Features

- Solid state components
- Easy to install and wire
- Field adjustable set points
- Input from nickel wire wound sensing elements
- Relay (SPDT) output

### General Description

The Series R34D compares the difference in temperatures at the two sensors with the two set point

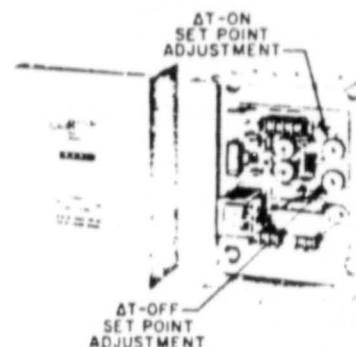


Fig. 1—Type R34DCA Differential Temperature Controller.

values. The results of that comparison control the operation of an internal SPDT relay.

The relay is energized when the temperature at sensor No. 2 (higher temperature sensor) exceeds that of sensor No. 1 (lower temperature sensor) by more than the "ON" setting. The relay remains energized until the difference in sensed temperatures is less than the "OFF" setting.

If the "OFF" setting equals or exceeds the "ON" setting, the minimum 1 F (½ C) operating differential is obtained. The relay is energized when the difference in sensed temperatures exceeds the "OFF" setting and de-energized if difference in sensed temperatures falls 1 F (½ C) below the "OFF" setting.

Series R34D controller is available in a NEMA Type 1 enclosure with four mounting holes in back of case, or in an open construction which mounts on four standoffs within a control panel. External wiring is connected to identified screw terminals.

### Specifications

Product	R34DCA	120 V., 50-60 Hz Input, NEMA Type 1 Enclosure
	R34DCB	120 V., 50-60 Hz Input, Open Construction
	R34DCG	24 V., 50-60 Hz Input, NEMA Type 1 Enclosure
	R34DCH	24 V., 50-60 Hz Input, Open Construction
Ambient Temperature At Controller		0 to 120 F ( - 18 to 49C)
Conduit Openings (NEMA Type 1 Models)		Combination Knockouts for ½" and ¾" Conduit, Three on Top, Three on Bottom
Electrical Connections		Identified Screw Type Terminals
Enclosure (NEMA Type 1 Models)		Cold Rolled Steel
Output Relay		SPDT (See Table for Electrical Rating)
Power Supply		24V A.C. or 120V A.C., 50-60 Hz, 5 Watts (9 VA)
Set Point Range (ΔT-ON and ΔT-OFF)		0 to 40 F (0 to 22 C)
Shipping Weight (Individual Pack)	With Enclosure	5.5 lbs. (2.5 kg)
	Open Construction	1.8 lbs. (.8 kg)

**Penn-Baso Products**



resistance sensing element. The duct sensor is available with NEMA Type 1 wiring enclosure or less enclosure. (See Figs. 2 and 3.)

The immersion sensor has a rigid tube on which the nickel wire is wound. It is supplied with a handi-box, adapter assembly and a brass bulb well. The brass well has a  $\frac{1}{2}$ " NPT connector. (See Fig. 1.)

The outdoor air sensor has the resistance element mounted in a weathertight conduit fitting with a metal cover. It has  $\frac{1}{2}$ " NPT female connector. (See Fig. 4.)

The high temperature sensor is less any mounting bracket or enclosure. (See Fig. 5.)

The nickel wire wound sensing element has a positive temperature coefficient of resistance. The resistance of the

element increases approximately 3 ohms per 1 degree Fahrenheit rise in sensed temperature. In typical control applications, the controller bridge is unbalanced when the temperature at the sensor varies with respect to the controller set point. The bridge produces a proportional signal which is amplified and is used to control actuators and sequencer.

See controller literature for typical wiring.

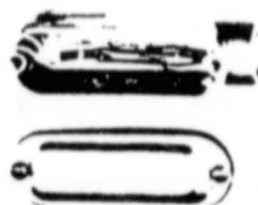


Fig. 4—Type A41QA Outdoor Air Sensor.



Fig. 5—Type A41WA Sensor.

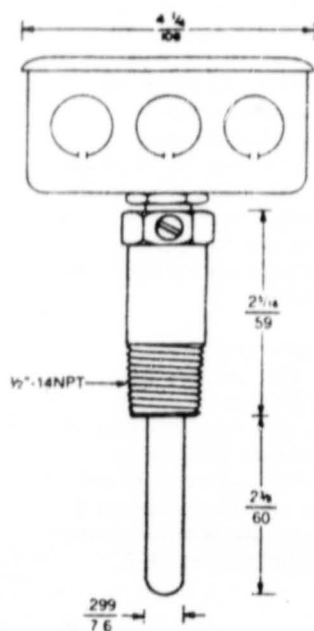
## Repairs and Replacement

Field repairs must not be made. For a replacement sensor or factory repair contact the nearest Johnson Qualified Commercial wholesaler handling Penn name brand controls or:

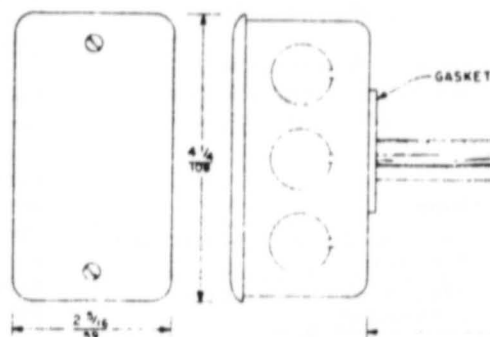
Johnson Controls, Inc.  
Control Products Division  
2221 Camden Court  
Oak Brook, Illinois 60521

## Ordering Information

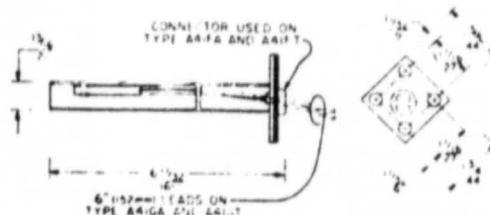
To order, specify complete Product Number, if available. If complete number is not available, specify Type Number and specifications.



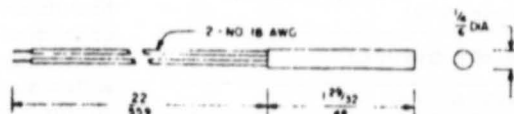
TYPE A41BA



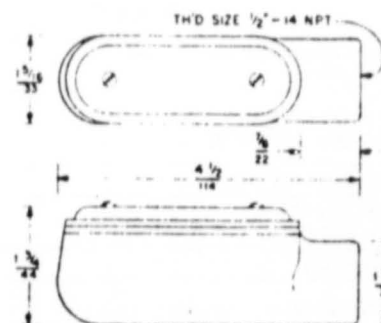
TYPE A41HA



TYPES A41F and A41G



TYPE A41WA



TYPE A41QA

A41 Dimensions  $\frac{\text{in}}{\text{mm}}$

Performance specifications appearing herein are nominal and are subject to accepted manufacturing tolerances and application variables.

## Repairs and Replacement

Field repairs must not be made. If the controller needs servicing or repair, return it to the factory. Replacement controllers and sensors may be obtained from the nearest Pen-Baso Wholesaler. When ordering a replacement controller or sensor, specify Product Number shown on the unit.

## Ordering Information

To order, specify:

1. Complete Product Number of controller.
2. Sensors required.

## Electrical Rating For Relay Contacts

Volts A C	120	208	240	277
Full Load Amps	5.8	5.4	4.9	—
Locked Rotor Amps	34.8	32.4	29.4	—
Non-inductive or Resistance Load Amps (Not Lamp Loads)	10.0	8.0	8.0	7.0
Pilot Duty—1 A., 24/125 V. A C., 125 VA., 125/240 V. A C.				
Rating is 10 Amps at 28 V. D C.				



Fig. 2—Type R34DCB Differential Temperature Controller.

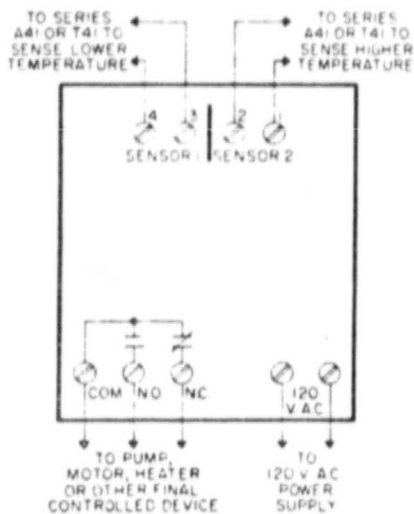


Fig. 3—Drawing of controller showing wiring connections.

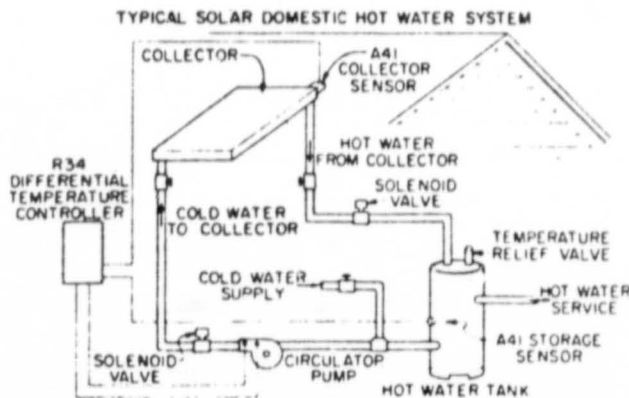
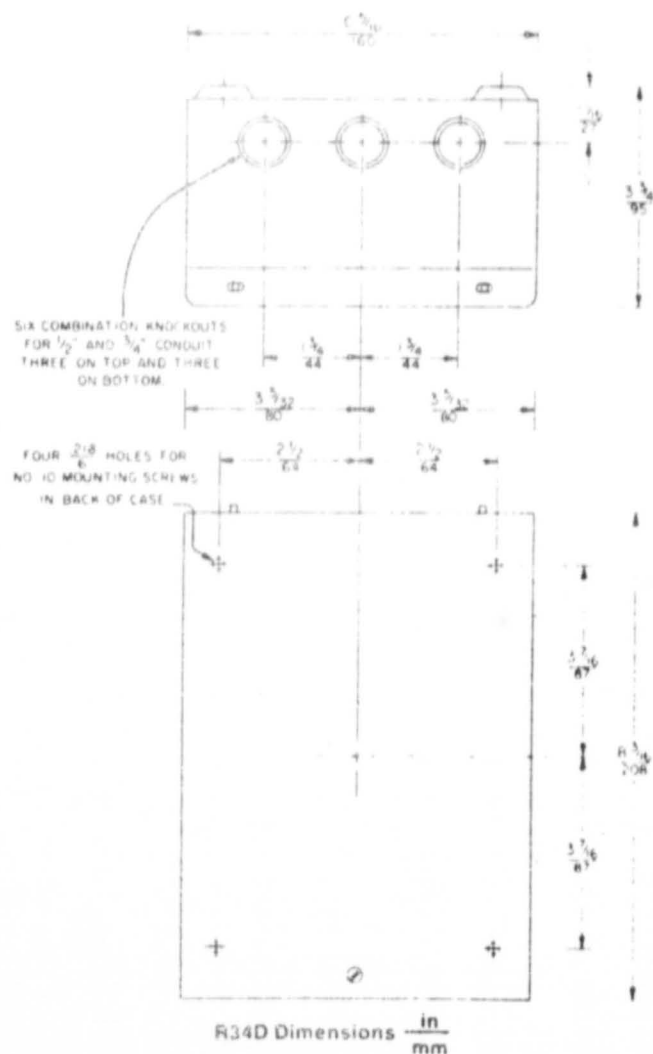
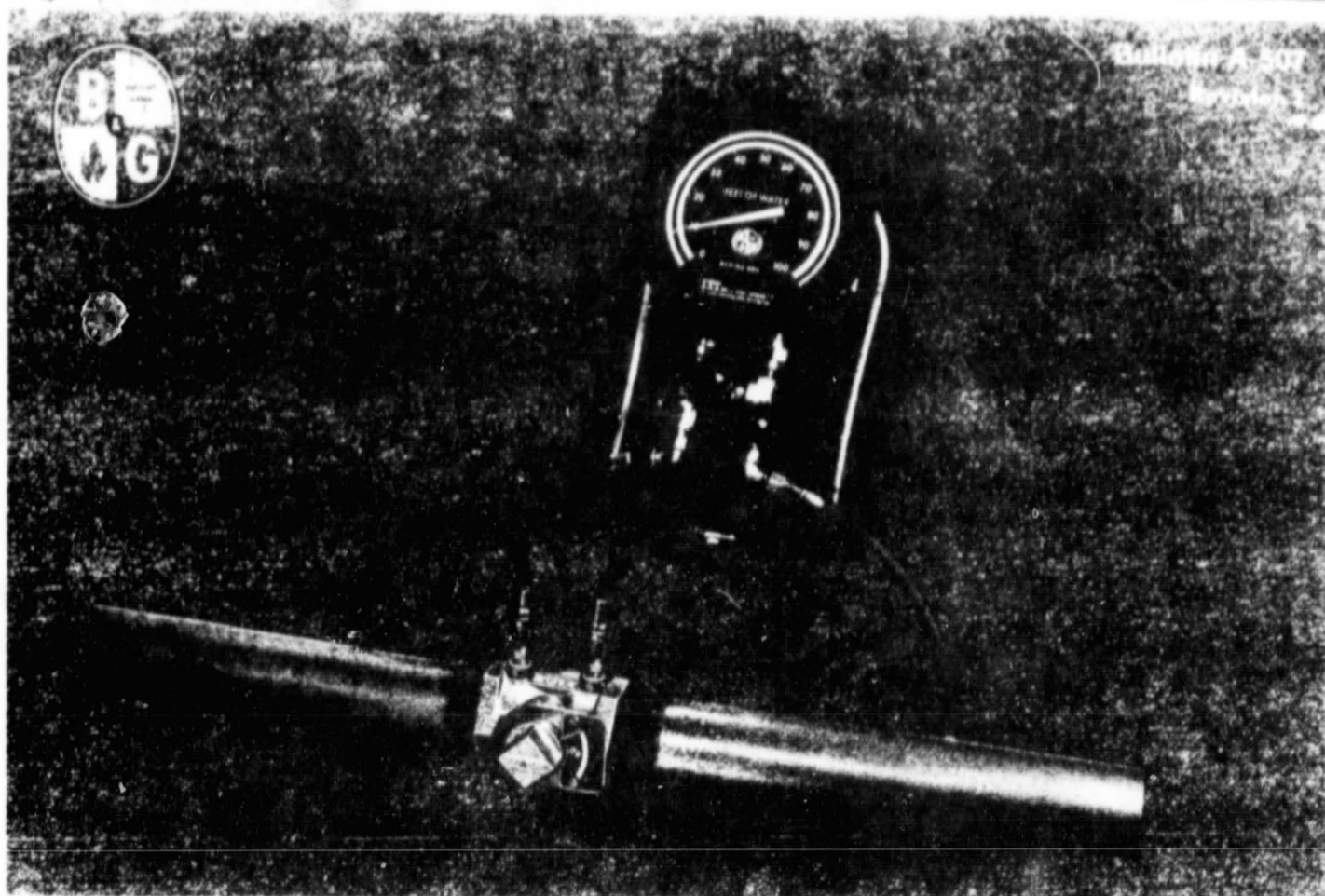


Fig. 4—Drawing of typical solar domestic hot water system.





# **CIRCUIT SETTER®**

## **BALANCE VALVE**

ACCURATE FLUID FLOW CONTROL  
AT YOUR FINGERTIPS  
PRESETS, BALANCES AND  
METERS SYSTEM FLOW  
AVAILABLE WITH NPT, FLANGED  
AND SOLDER CONNECTIONS

**BELL & GOSSETT ITT**  
FLUID HANDLING DIVISION

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DUAL STAGE  
ORIFICE DESIGN  
ASSURES QUIET  
ON THE JOB  
PERFORMANCE

INDICATING  
POINTER

CALIBRATED  
NAME PLATE  
PERMITS ACCURATE  
SYSTEM BALANCE

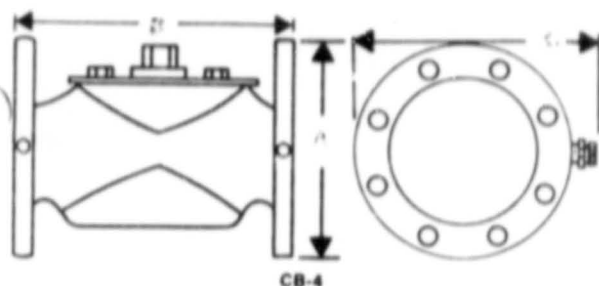
READOUT VALVE PORTS  
EQUIPPED WITH B&G  
RV-125A READOUT VALVES  
FEATURING UNIQUE  
INTEGRAL EPT CHECK  
VALVE.

RUGGED BRONZE  
CONSTRUCTION

INTERNAL O-RING  
SEALS PREVENT LEAKAGE

PRECISION MACHINED ORIFICE

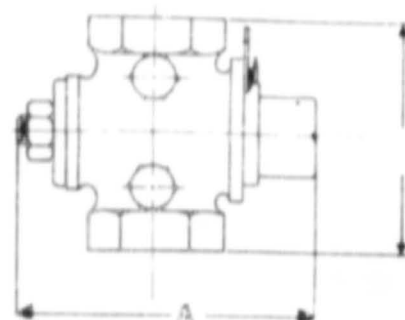




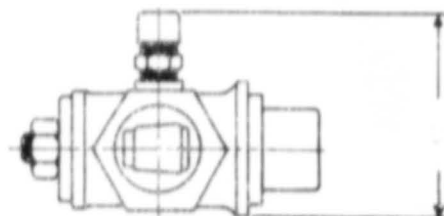
CB-4

# DIMENSIONS AND WEIGHTS

Model No.	DIMENSIONS IN INCHES								Weight in Lbs.
	Size								
			Normal	Insul	Normal	Insul	Normal	Insul	
CB- ½	½	NPT	2¾	4¼	2⅝	4¼	2¼	4¼	¾
CB-¾	¾		2⅞			2¼			2⅜
CB-1	1		3½	5½	2⅝	3⅜	2⅝	4¾	1½
CB-1¼	1¼		3⅝				3		
CB-1½	1½		4⅝	6¼	3⅝	4¼	3⅝	6	3½
CB-2	2		5⅝				4⅝		
CB-2½	2½		7⅝	9	5⅝		4½	7	16
CB-3	3		8				6⅝		7
CB-4	4	FLG	9	9⅝	8	8	10⅝	10⅝	52



CB-1/2 THRU CB-3



# DIMENSIONS AND WEIGHTS

Model No.	DIMENSIONS IN INCHES							Weight in Lbs.
	Size	A		B		C		
		Normal	Insul	Normal	Insul	Normal	Insul	
CB-1/2S	1/2	1 1/8	4 1/4	2 1/4	4 1/4	2 3/4	4 1/4	3/4
CB-3/4S	3/4			2 5/8		2 7/8		1

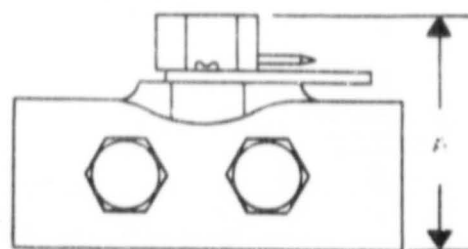
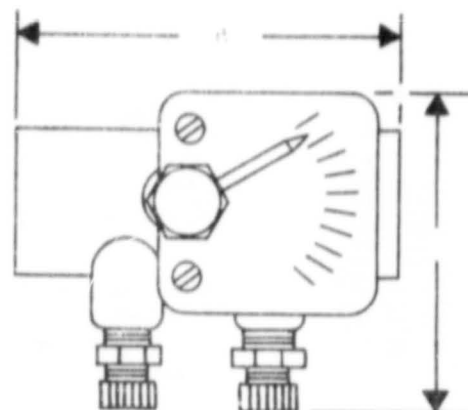
## TYPICAL SPECIFICATION

Furnish and install as shown on plans, a calibrated (bronze/cast iron with bronze disc) balance valve equipped with readout valves to facilitate the connecting of a differential pressure meter. Each readout valve shall be fitted with an integral EPT check valve designed to protect the user from the system fluid before, during and after the monitoring of system flow. The balancing valve shall have an indexing pointer and calibrated nameplate to indicate the degree of closure of the precision machined orifice. Each balancing valve is to be constructed with internal EPT o-ring seals to prevent leakage around the rotating element. The balancing valves shall be supplied with preformed polyurethane insulation, suitable for use on heating and cooling systems, to protect the precision balancing valve during shipment.

Each balancing valve shall be ITT Bell & Gossett Model No. CB-\_\_\_\_\_ or approved equal.

## IMPORTANT

- Models CB-1/2 thru CB-3 are suitable for use as service valves, but not as leak-proof shut-off valves.
- Models CB-1/2S, CB-3/4S and CB-4 are designed to be used as circuit balance valves only. They are not designed for use as shut-off valves or service valves.
- B&G Circuit Setter Balance Valves are not recommended for use with meter connections pointing downward.



CB-1/2S and CB-3/4S

ORIGINAL PAGE IS  
OF POOR QUALITY

## INSTRUCTION SHEET

G97035  
REVISION 1RV-125A  
(G97030)

## Readout Valve

The RV-125A Readout Valve is equipped with an integral EPT Check Valve designed to protect the user from being wetted when setting up to monitor pumps, heat exchangers, valves, etc., handling hot or cold water.

**IMPORTANT**

Although these valves are fitted with integral check valves, caution should be exercised to avoid direct contact with liquids at temperatures in excess of 120°F.

**MAXIMUM OPERATING LIMITATIONS**

Working Pressure 250 PSIG  
Temperature 250°F.

**CONNECTION SIZE**

RV-125A-Top:  $\frac{3}{8}$ "-24 UNF THD  
Bottom:  $\frac{1}{8}$ " NPT

**NOTE:**

Use only B&G Companion Readout Probes to obtain accurate readout of the RV-125A Readout Valve.

**IMPORTANT:** The RV-125A Readout Valve is not interchangeable with the C79284 Schrader Valve previously used on circuit setters unless the circuit setter readout ports are opened to a  $\frac{5}{8}$ " minimum tap drill depth or  $\frac{7}{16}$ " minimum tap drill depth with a  $\frac{7}{32}$ " minimum drill through.

RP-250B  
(G97032)

## Readout Probe

These Readout Probes are designed for use with the B&G RV-125A Readout Valve.

**MAXIMUM OPERATING LIMITATIONS**

Working Pressure 250 PSIG  
Temperature 250°F.

**CONNECTION SIZE**

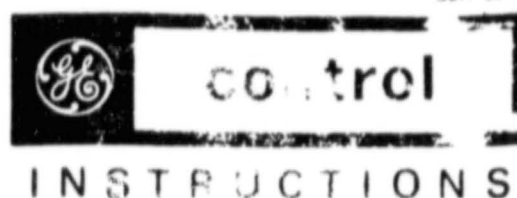
RP-250B:  $\frac{1}{8}$ "-20 UNF-2A THD  
Ferrule Nut  $\frac{3}{8}$ "-24  
UNF-2B Internal THD

with Ferrule Nut  
for permanent  
installation

## Directions for Use

1. Connect Readout Probe to Pressure Gauge or Differential Pressure Meter with  $\frac{1}{4}$ " FPT connection.
2. Insert full length of Probe into Readout Valve and tighten ferrule nut.
3. Read Pressure(s).
4. Periodically inspect Probe for blockage by visual or other means.





CR205X120N and X130N

## pushbutton and selector switch kits

FOR NEMA SIZE 00, 0 AND 1 MAGNETIC STARTERS

### FLEXIBILITY OF KITS

The Start-Stop Pushbutton Kit and Hand-Off-Auto Selector Switch Kit are designed for use on sizes 00, 0 and 1 magnetic contactors and starters—CR205, CR206, CR207 and CR208.

These kits enable you to mount a pilot device in the cover of a General Purpose Type 1 enclosed starter, the result—one single, compact, and economical unit. The component parts of these kits are shown in Fig. 1 and 1A.

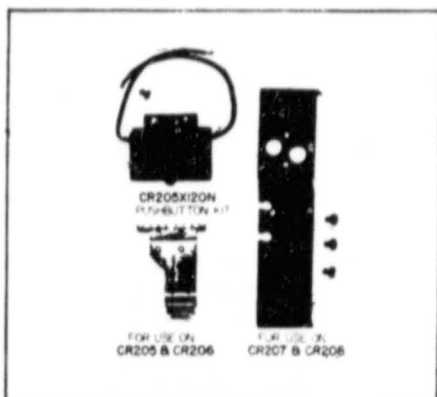


Figure 1 - Component parts of Pushbutton Kit

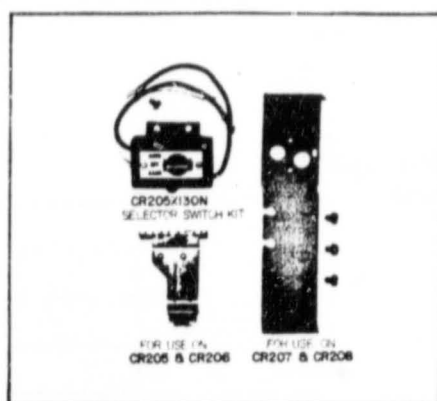


Figure 1A - Component parts of Selector Switch

### EASE OF INSTALLATION - (pushbutton kit)

The CR205X120N pushbutton kit comes complete with necessary hardware and ready for installation on the control device. The following steps are used for installing a Pushbutton on CR205 and CR206 devices only.

1. Remove power from device.
2. Loosen mounting screws and remove device from enclosure.
3. Begin disassembly of contactor by pressing slightly on coil and pulling up on coil retainers; motion also being away from coil (see Figure 2).
4. Withdraw spring clip from movable portion of magnet assembly.
5. Remove magnet portion and coil from starter (or contactor).
6. Insert dove tail bracket (for CR205, CR206) into keyed slot at top of the molded cover, as shown in Fig. 4. Reassemble starter (or contactor).
7. Slide the pushbutton onto the mounting bracket as shown in Fig. 5, using the circular slots of the bracket.
8. Insert red wire into terminal marked "3" on top of contactor.
9. Connect black wire to "L1". Make connection at terminal screw provided. (see Figure 2).
10. Connect white wire on pushbutton to terminal marked "2" on bottom of contactor, or to terminal marked "2" on overload relay of starter.
11. Re-install device in enclosure and tighten mounting screws.
12. Remove large rectangular knockout from enclosure cover by applying force with a screwdriver from front side of cover.
13. Adjust pushbutton on its mounting bracket to line up with hole in cover. Tighten pushbutton mounting screws.

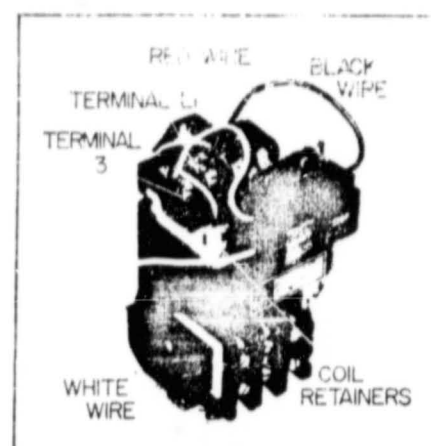


Figure 2 - CR205X120N installed

### EASE OF INSTALLATION - (selector switch kit)

The CR205X130N Selector Switch Kit comes complete with necessary hardware, ready to install on the control device. The following steps are used for installing Selector Switch on CR205 and CR206 devices only.

1. Follow steps 1 through 8 in Pushbutton Kit instructions for CR205 and CR206 devices.
2. Remove and discard wire running from terminal marked "3" on top of contactor to coil terminal.
3. Connect white wire to terminal marked "3" on contactor.
4. Connect black lead to top coil terminal.
5. Connect red wire to terminal marked "L1".
6. If maintained contact device is in circuit, connect between terminals marked "L1" and "3".
7. Remount device in enclosure and tighten mounting screws.
8. Remove large rectangular knockout from enclosure cover by applying force with a screwdriver from front side of cover.

**55-155562**

## INSTRUCTIONS

**Test on page**

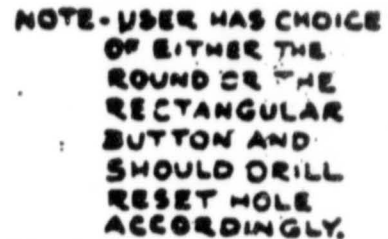
54 55.

**Don't be late!**

94 25A

**FIRST MADE FOR**

● 2. 510.8



**NOTE**-DISTANCE FROM UNDERNEATH SIDE OF  
ENCLOSURE COVER TO STARTER  
MOUNTING BASE MUST BE 4  $\frac{3}{4}$ "

20

P4.N12 10

Mar 1 80  
 Boston to New York via 17 1960  
 Flamingo 19 1960  
 00-41276 0-10

Shuck

GENERAL PURPOSE CONTROL  
DEPARTMENT  
BLOOMINGTON, ILL.

**55-155562**

**Leave no trace**

92 93

D-2

**RPC**

GENERAL ELECTRIC

546A741  
CONT ON SHEET FL. SH NO. 1

REV. NO.

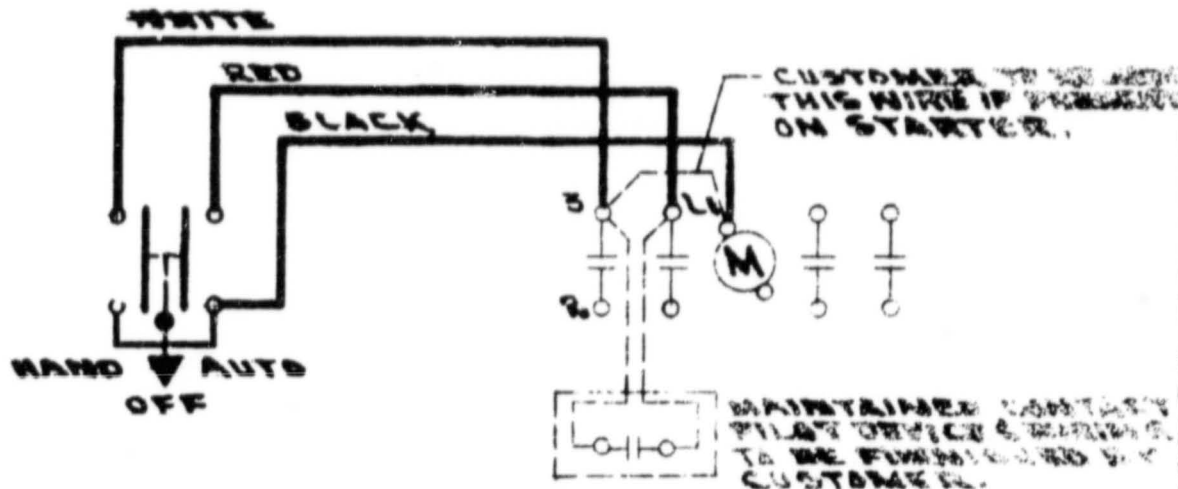
TITLE WIRING DIAGRAM

546A741

SELECTOR SWITCH KIT

CONT ON SHEET FL. SH NO. 1

FIRST MADE FOR CR125X1308



~ NOMENCLATURE ~  
M-LINE CONTACTOR

CONNECTIONS ABOVE ARE FOR 3 PHASE CR100, 103, 105 & 108 ENCLOSED CONTACTORS & STARTERS WHEN MINIMATUR SELECTOR SWITCH KIT IS USED.

PR2  
AC

PRINTS TO

MADE BY  
Herb Price May 28, 1957  
ISSUED  
May 31, 1957

APPROVALS  
R. Smyth

GENERAL PURPOSE CONTROL  
DEPARTMENT  
BLOOMINGTON, ILL.

546A741  
CONT ON SHEET FL. SH NO. 1

CO-610-PC (8-56)

D-3

G.P.C.

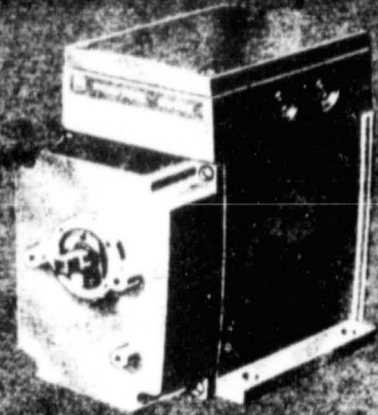
# Honeywell

THE M445 AND M845 ARE 2 POSITION, SPRING RETURN MODUTROL MOTORS. THEY ARE USED TO OPERATE DAMPERS OR VALVES IN APPLICATIONS WHERE IT IS NECESSARY OR DESIRABLE TO HAVE THE CONTROLLED ELEMENT RETURN TO THE STARTING POSITION IN THE EVENT OF POWER FAILURE OR INTERRUPTION.

- ☐ The M445 operates on line voltage; the M845 operates on 24V ac.
- ☐ The M445C and M845B are equipped with internal, thermostatically controlled heaters for use in cold weather applications.
- ☐ The M445B and M845E are designed for normally open valves; all other motors are normally closed.
- ☐ All models have a one minute, 160 degree stroke.
- ☐ Sturdy, lightweight, die-cast aluminum case.
- ☐ Integral spring returns motor to normal position when power fails or is interrupted.
- ☐ Built-in spdt adjustable switch is available on some models for the control of auxiliary equipment.
- ☐ Oil immersed gear train assures long life and quiet operation.
- ☐ Full line of accessories includes weather-proofing kit and explosion-proof housing as well as auxiliary switches and a number of linkages.
- ☐ Tradeline M845A includes multitap transformer for 120/208/240V ac control circuits.

S.K.  
REV. 7-75 (.025)

## MODUTROL MOTORS



M445 A,B,C,D  
M845 A,B,C,E

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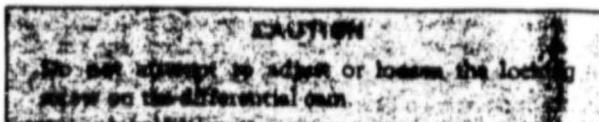
# ADJUSTMENTS

## AUXILIARY SWITCHES

The M445 and M845 Modutrol Motors have an auxiliary switch that can be adjusted to operate at any point in the stroke of the motor. See Fig. 16. This switch may be adjusted approximately without running the motor by using the following procedure:

1. Remove the "C" clip holding the drive bracket against the spring hub. Take off the drive bracket. Refer to Fig. 18.

2. Remove the 4 screws from the corners of the return spring housing and pull the housing and spring straight out.



3. With the motor in the normal position, loosen the adjustment screw for the operational cam. See Fig. 17. Using the 10-degree marks on the cam and a fixed point such as the cam roller for a guide, rotate the cams clockwise (counterclockwise for normally open motors) through an arc equal to the number of degrees the motor should travel before switch operates. Tighten the operational cam adjustment screw.

4. Replace the spring and return spring housing using the 4 screws removed earlier.

5. Replace the drive bracket and "C" clip.

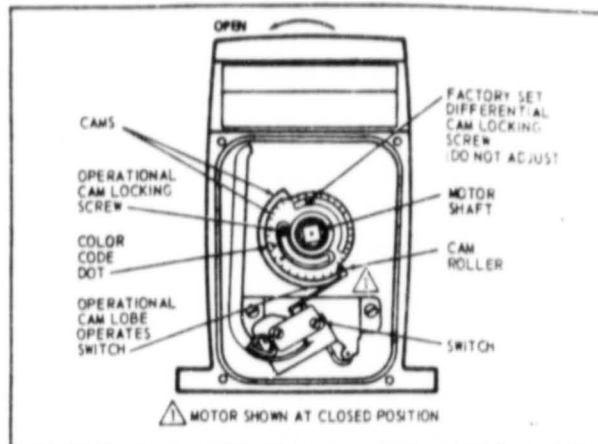


FIG. 16—LOCATION OF AUXILIARY SWITCH IN THE M445 OR M845 MODUTROL MOTOR.

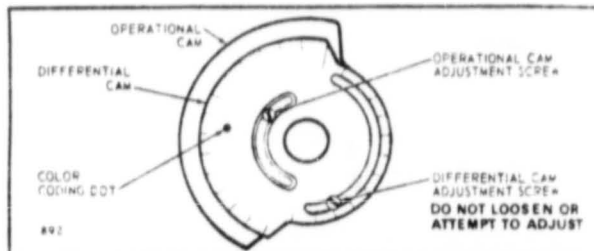


FIG. 17—SWITCH CAM MAY BE ADJUSTED TO OPERATE THE SWITCH DURING ANY PART OF THE STROKE.

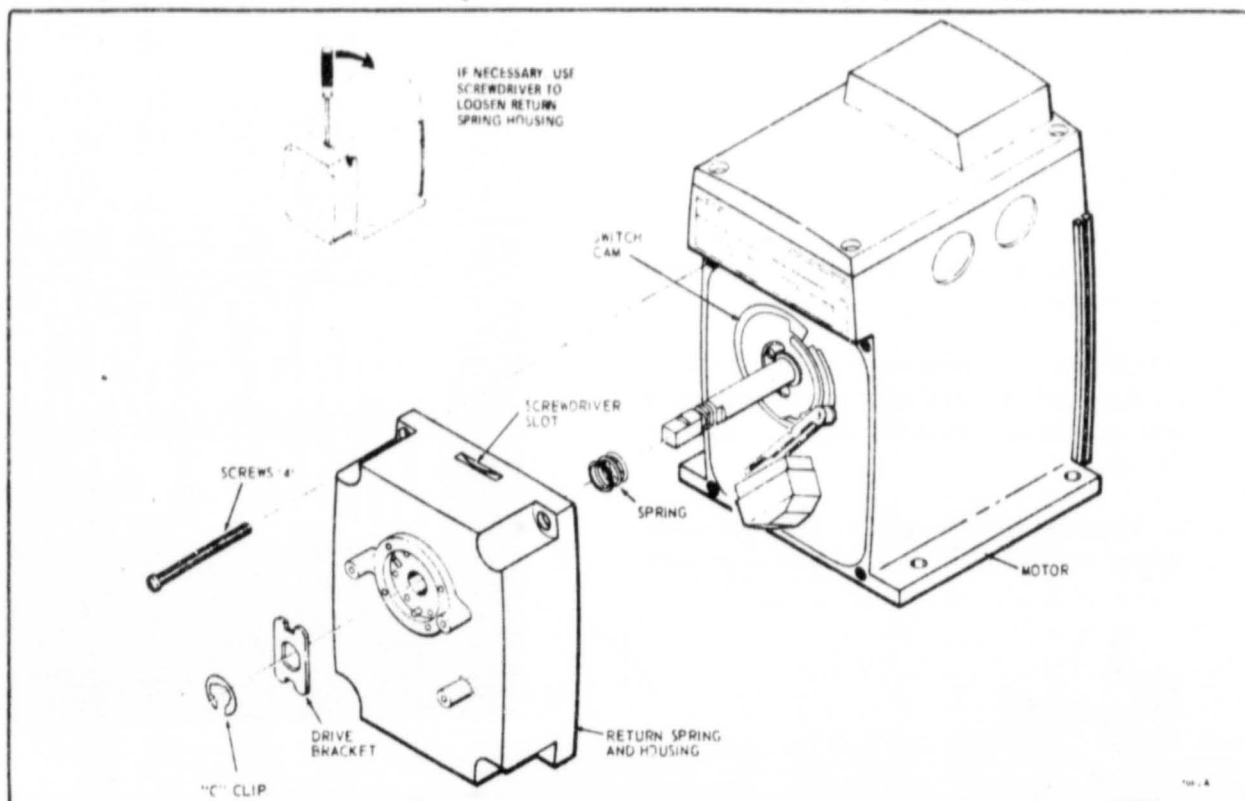


FIG. 18—REMOVING THE RETURN SPRING HOUSING TO ADJUST AUXILIARY SWITCH.



After the installation is complete, check the entire system for the following points of operation:

1. Motor operates the load properly.
2. Motor responds properly to the controller.
3. Motor returns to the starting position when power is interrupted.

## DAMPER OPERATION

### STEP 1

Check the entire motor-damper linkage to see that the mechanical connections are secure and properly made. Make sure the ball joint on the damper crank arm is properly placed to give the required amount of travel.

### STEP 2

Energize the motor and run it to the full open position. Check the damper linkage while the motor is running to see that there are no loose or binding connections.

If the motor does not begin to run, check the control circuit for an "open" or "short," the presence of power, and the amount of power available at the motor. (The voltage at the motor must be at least 85 percent of the rated voltage on the nameplate.) Make sure that the maximum net load of the motor is not exceeded.

### STEP 3

Interrupt the power to de-energize the motor and allow the spring to return the motor to the starting position. If the motor does not return, check to see that power is actually interrupted and that the return load is not exceeding the rated motor load.

## VALVE OPERATION

### STEP 1

Check the entire motorized valve assembly to see that the mechanical connections between the motor, linkage, and valve are proper and secure. Make sure that the linkage is adjusted according to the linkage instructions. Leave the cover off the linkage until the checkout is completed.

### STEP 2

Make sure that the load does not exceed the motor rating. When using a Q601 Linkage with the motor, lubricate the bearing surfaces to prevent excessive loading. The valve packing must not be too tight. The motor actuating arm must be installed against the shoulder of the motor shaft to prevent binding at the connecting linkage bearings.

### STEP 3

Energize the motor by setting the controller so that its contacts close. The motor should start and run smoothly, and the valve stem should move to the opposite end of its stroke. If this is not the case, make sure that there is power to the motor. If there is no power, check the controller circuit for open or short circuits. If the trouble still cannot be found, measure the voltage at the source supply. Line voltage must be at least 85 percent of the rated voltage stamped on the nameplate of the motor.

### STEP 4

De-energize the motor by resetting the controller so its contacts open, or remove one of the wires from a controller terminal. Spring power should return the valve to its normal position. If this does not happen, check the linkage for binding or in the case of normally closed valves, check for fluid pressure in excess of the close-off rating.

### STEP 5

Replace the linkage cover.

## OPERATION

In an operational circuit, a single-pole, single-throw controller (line voltage for M445 or low voltage for M845) is wired in series with the motor circuit. When the controller switch closes, the motor is energized and runs to the end of its stroke. At this point, the limit switch is opened and the motor is de-energized.

The brake solenoid is energized, however, and remains so as long as the controller is closed. The brake holds the motor in the open position until the controller opens. At this point the brake is released and the spring on the motor returns it to the starting position.



## TRADELINE MODELS

Tradeline models of this device are selected and packaged to provide ease of stocking, ease of handling, and maximum replacement value. Tradeline model specifications are the same as those of standard models except as noted below:

**TRADELINE MODELS AVAILABLE:** M845A Modutrol Motor—2 position, spring return motor for use with dampers and normally closed valves. An internal spdt switch is provided for actuating auxiliary equipment. Motor operates from 24V ac and includes a cover mounted transformer for 120/208/240V ac control circuits.

**ELECTRICAL RATINGS:** Voltage and frequency—motor requires 24V ac, 60 Hz. Cover mounted

transformer has 120/208/240V ac multitap primary and 24V ac secondary.

### ADDITIONAL FEATURES:

- Multitap transformer for 120/208/240V ac control circuits.
- Tradeline pack with cross reference label and special instruction sheet.

## STANDARD MODELS

### MODELS:

The M445 and M845 are 2 position, spring return Modutrol motors with 1 internal auxiliary spdt switch. They are for use with dampers and normally closed valves (except M445B and M845E are for normally open valves).

M445A—Modutrol motor as described above for line voltage operation.

M445B—Modutrol motor as described above for line voltage operation with normally open valves.

M445C—Modutrol motor as described above for line voltage operation. Includes internal thermostatically controlled heater.

M445D—Modutrol motor as described above for line voltage operation; without auxiliary switch.

M845A—Modutrol motor as described above for 24 volt operation. Available with 120/208/240V ac multitap cover mounted transformer (see Tradeline specifications).

M845B—Modutrol motor as described above for 24 volt operation. Includes internal thermostatically controlled heater. Available with 120V ac cover mounted transformer.

M845C—Modutrol motor as described above for 24 volt operation; without auxiliary switch.

M845E—Modutrol motor as described above for 24 volt operation with normally open valves. With 120V ac cover mounted transformer.

### ELECTRICAL RATINGS:

MODEL	WATTS	VA	VOLTAGE, AC 50/60 HZ
M445A	17	21	120, 208, 220 <sup>a</sup> , 240
M445B	17	21	120
M445C	47 <sup>b</sup>	53	120
M445D	17	21	120
M845A <sup>c</sup>	18	21	24
M845B <sup>c</sup>	49 <sup>b</sup>	51	
M845C	18	21	
M845E <sup>d</sup>	18	21	

<sup>a</sup>50 Hz only.

<sup>b</sup>Including 30 watts for internal heater.

<sup>c</sup>Available with cover mounted transformer.

<sup>d</sup>Includes cover mounted transformer.

### AUXILIARY SWITCH RATING<sup>a</sup> (in amperes):

	120V AC	240V AC
Full Load	7.2	3.6
Locked Rotor	43.2	21.6

<sup>a</sup>Switch rating is for one contact only; if both are used, second contact is rated 40 VA.

(continued on page 3)

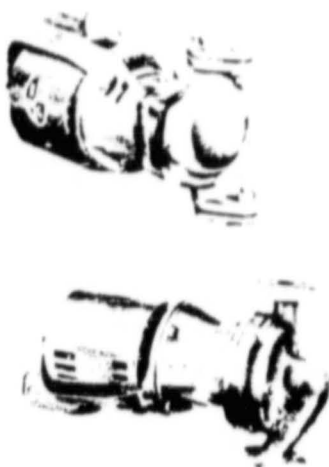
## ORDERING INFORMATION

WHEN ORDERING REFER TO THE TRADELINE CATALOG OR PRICE SHEET FOR COMPLETE ORDERING SPECIFICATION NUMBER.

1. MODEL NUMBER, SPECIFY TRADELINE IF DESIRED.
2. VOLTAGE AND FREQUENCY ON MODELS WITH COVER MOUNTED TRANSFORMER AVAILABLE. SPECIFY WHEN ORDERING.
3. ACCESSORIES, IF REQUIRED.

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## INSTRUCTION SHEET

S16946

REVISION 4

Also replaces  
Instruction Manual S17630

# BOOSTER AND SERIES "60" IN-LINE CENTRIFUGAL PUMPS

## INSTALLATION, OPERATION AND SERVICE INSTRUCTIONS

### INSTALLATION INSTRUCTIONS

#### LOCATION

If the pump is not installed on a closed system it should be placed as near as possible to the source of supply, and located to permit installation with the fewest possible number of bends or elbows in the suction pipe.

#### ALIGNMENT

The compact construction of this pump makes it very unlikely that any misalignment of parts will occur, but a check should be made before putting the pump in service by turning the shaft by hand to determine that there is no binding.

#### PIPING

It is important that air be kept out of the system. On an open system always place the end of the suction pipe at least 3 feet below the surface of the water in the suction well to prevent air from being drawn into the pump. Avoid air pockets in the suction line and make sure that each section of the suction pipe is absolutely air tight.

Install a square head valve and a check valve in the discharge pipe close to the pump. The check valve should be between the square head valve and the pump discharge nozzle. The square head valve can be used to control the capacity of the pump or to shut off the discharge line while repairs are being made. The function of the check is to protect the pump casing from breakage that might occur due to the action of water hammer.

A 10-32 NF eye bolt has been included with the larger pump packages, use of which is optional, to enable supporting the bearing bracket from above the pump when the piping is not able to provide the necessary support.

Do not support under motor, misalignment will occur.

#### SYSTEM PREPARATION

Prior to pump start up, the system should be cleaned with a trisodium phosphate solution, flushed and drained. Then refilled with clean liquid. The PH should be maintained between 7 and 8.

#### PRIMING

**DO NOT RUN PUMP DRY.** Before starting, these pumps must be filled with water. After the pump has been filled, turn the shaft a few times by hand to allow all air to escape and if necessary add more water. The square head valve in the discharge should be kept closed until the pump is running at full speed and then gradually opened.

#### LUBRICATION

All new Bell & Gossett Boosters and Series "60" in-line centrifugal pumps are test run at the factory, but must be lubricated before being placed in operation.

Lubricate as follows:

1. Pump Bearings—Fill the bearing frame per oiling instruction tag with SAE #20 oil until oil flows from the overflow hole on the side of the bearing bracket. PD38, PD40 and Series 60 "A" size pumps are to be lubricated until oil level is up to the side hole. Relubricate as necessary to maintain this level.
2. Sleeve Bearing Motor—Lubricate thru the two motor oil cups per motor lubrication tag once every four months. Use ten to fifteen drops in each oil cup if required.
3. Ball Bearing Motor—Relubricate every six months to two years depending on operating conditions with a good soda-soap or lithium base grease.

NOTE: Over-oiling can cause deterioration of the motor mounts which in turn causes excessive coupler wear from misalignment.

### OPERATING INSTRUCTIONS

1. Be sure to operate the pump in the proper direction. All PD and Series 60 run clockwise when looking at the pump from the motor end. All boosters run counterclockwise when looking at the pump from the motor end. All pumps are provided with arrows showing direction of rotation.
2. Keep pump and motor bearings lubricated.
3. Do not disassemble pump unless absolutely necessary as impeller has been accurately adjusted and tested before leaving factory.
4. Pump shaft should always turn freely by hand.
5. Ask for information or help if trouble is experienced that cannot be rectified since this pump is guaranteed to operate as recommended.
6. If pumps are to be idle for a very long period of time the interior of the volute should be cleaned and oiled. This prevents parts from rusting together and assures a longer period of satisfactory operation.
7. The motor should be protected against overload and under-voltage. Control devices for this purpose can be obtained at a very low cost. They are inexpensive insurance.

(OVER)

**BELL & GOSSETT** **ITT**  
FLUID HANDLING DIVISION

## SERVICE INSTRUCTIONS

An exclusive feature of the B & G Booster & Series "60" pumps is the availability of complete bearing bracket assemblies as replacements.

In those cases where it may be necessary only to replace the seal assembly the following instructions apply:

1. Turn off current to motor.
2. Close valves on both sides of pump (If no valves have been installed, it may be necessary to drain the system).
3. Detach bearing-frame assembly from pump volute by removing eight cap-screws from center body-flange.
4. Remove impeller from pump-shaft (First turning impeller-nut counter clockwise).
5. Lift off seal-spring — then place screwdriver point under top compression ring of seal and pry off. Seal can then be removed by pulling upward.
6. Be sure that the shaft is thoroughly cleaned then lubricate with a thin film of oil or water and push the replacement seal on as far as possible by hand. Next, using a screwdriver press down firmly all around the outer edge of the top compression ring until the seal is tight against the face of the remote insert. If end play is present push the seal on tighter.
7. Replace impeller on shaft making certain that impeller-nut is firmly tightened. The pump and bracket can then be reassembled into pump volute and placed in service.

### HOW TO REPLACE THE COUPLER ASSEMBLY

- A — Turn off current to motor.
- B — Remove bearing bracket cover.
- C — Loosen coupler half from pump shaft by turning Allen set screw counter-clockwise.
- D — Remove four cap screws that connect motor bracket to pump bracket and slide motor away from bracket. If coupler sticks on pump, insert screwdriver between rear bearing and coupler half, exerting pressure outward. Loosen set screw on motor coupling half and remove coupling.
- E — Install new coupler, slipping one coupling half on motor shaft first and tighten set screw. Slip other coupling half on pump shaft, tighten set screw and bolt motor bracket to pump bracket. Replace bearing bracket cover.

#### CAUTION:

Do not attempt to replace individual coupler springs. If coupler arms are worn or springs are broken, always replace entire coupler assembly.

### HOW TO REPLACE THE RING MOTOR MOUNTINGS

- A — Turn off current to motor.
- B — Disconnect motor leads.

C — Remove coupler from motor shaft

D — Loosen rear clamp on motor using screwdriver to pry off clamp motor can then be lifted out of bracket.

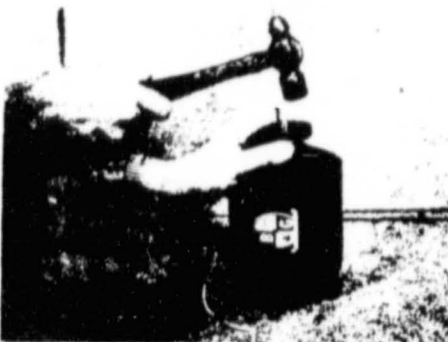
E — Place screwdriver between front mounting and end-bell of motor and strike firmly with a hammer on handle of screwdriver, forcing inner ring of motor mounting off the boss of end-bell. (Figure 1)

F — To install motor mounts, hold mounting firmly against boss of end-bell and tap inner ring lightly until mounting has started. Continue to tap around the inner ring (compression ring) until mounting is flush with end of boss. (Figure 2) Repeat procedure with rear mount, however, do not rest motor on end of shaft when applying this unit.

G — Replace motor in bracket with oil well spouts up and tighten clamp.

H — Reconnect coupler and turn shaft by hand to make sure it is free.

I — Reconnect motor leads and turn current back on.



# CUMMINS-WAGNER Co. Inc.

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ATTN: Mr. Tom Rust

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☐ EST.

☒ QUOTE 12/8/78

PAGE 1

OF 4

CW# 08-1646C

☐ ORD.

☐ ORD. ACK.

☒ SUBMIT 1/213/78

Cummins-Wagner Co. Inc. (Seller) is pleased to furnish the addressee (Customer) the following items in the quantities and at the prices shown in strict accordance with all the terms and conditions shown on the face and reverse side of each page.

ITEM	QTY.	DESCRIPTION	UNIT WT.	UNIT PRICE	DISC.	TOTAL PRICE
1	1	Pump P-1- 60 GPM @ 70'hd B&G 1510-1 $\frac{1}{4}$ BB bronze fitted 3 HP, 1750 RPM, ODP 208/30/60 frame 182T *NOTE: 3 HP required in lieu of 2 HP specified	196			
2	1	Pump P-2-30 GPM @ 60' hd B&G 1510-1 $\frac{1}{4}$ BB bronze fitted 2 HP, 1750 RPM, ODP 208/30/60 frame 145T *NOTE: 2 HP required in lieu of 1 $\frac{1}{2}$ HP specified	177			
3	1	Pump F-3-7 GPM @ 25' hd B&G 60-B11S (1 $\frac{1}{4}$ AA) with $\frac{1}{4}$ HP, ODP, 115/10/60	60			
4	1	Air Separator- 75 GPM B&G RL -2	55			

ACCEPTANCE

CO. \_\_\_\_\_

BY \_\_\_\_\_ DATE \_\_\_\_\_

RESPECTFULLY SUBMITTED

CUMMINS - WAGNER CO. INC.

BY \_\_\_\_\_

Wally Bass

# CUMMINS-WAGNER Co. Inc.

10939 MD. RT. 32, ANNAPOLIS JUNCTION, MD. 20701  
BALTIMORE: (301) 792-4230 - WASHINGTON: (301) 953-9370  
DEL. - PA. - VA. - W. VA.: (800) 638-4427

## MECHANICAL EQUIPMENT SALES & SERVICE

AIR COMPRESSORS  
AIR DRYERS  
AIR FILTERS  
AFTER COOLERS  
BLOWDOWN SYSTEMS  
BOILERS  
BOILER FEED

CONDENSATE RETURN  
DEAERATORS  
FLOW CONTROLS  
GAUGES  
HEAT EXCHANGERS  
HYDRONIC SPECIALTIES  
INSTRUMENTATION

LEVEL CONTROLS  
MOTORS  
PACKAGES (CUSTOM)  
PLUMBING SPECIALTIES  
PRESSURE REGULATING  
PUMPS (ALL TYPES)  
TEMPERATURE REGULATING

THERMOMETERS  
SOLAR PRODUCTS  
STEAM SPECIALTIES  
STRAINERS  
TANKS  
VACUUM SYSTEMS  
WATER HEATERS

REF. Arl gtn. Racquet bl.		QU#	1081	CW#	PAGE 2		OF 4	
ITEM	QTY.	DESCRIPTION			UNIT WT.	UNIT PRICE	DISC.	TOTAL PRICE
5		<u>Balancing Valves</u> - B&G Circuit Setters						
	1	a) CB-2						
	4	b) CB-1½						
6	1	<u>Read Out Meater</u> - for balancing valves B&G RC-5						
7		<u>Triple Duty Valves</u> - (for Pump P1 & P2)			30			
	2	B&G #3DS-2- size 2"						
8		<u>Solar Heatexchanger</u> - HE-1						
	1	B&G TCW-684			111			
9		<u>Pressure Gauges</u> -						
	7	Weksler EA-14, range 0-60 PSIG						
10		<u>Thermometers</u> -						
	12	Weksler 3A04 20-240 °F bi-metal, back angle thermometer						
11		<u>Backflow Preventer</u> -			19			
	1	Lawler RZ-3-S with two stop valves & strainer size 3/4"						
12		<u>Expansion Tank</u> -						
	1	B&G #30, 30 gallon 125 PSIG ASME, painted with:						
	1	a) ATF-12 tank airtrol fitting						
	1	b) DT-2 tank drain						
		(less gauge glass)			G-2			



## MECHANICAL EQUIPMENT SALES & SERVICE

AIR COMPRESSORS  
AIR DRYERS  
AIR FILTERS  
AFTER COOLERS  
BLOWDOWN SYSTEMS  
BOILERS  
-BOILER FEED

CONDENSATE RETURN  
DEAERATORS  
FLOW CONTROLS  
GAUGES  
HEAT EXCHANGERS  
HYDRONIC SPECIALTIES  
INSTRUMENTATION

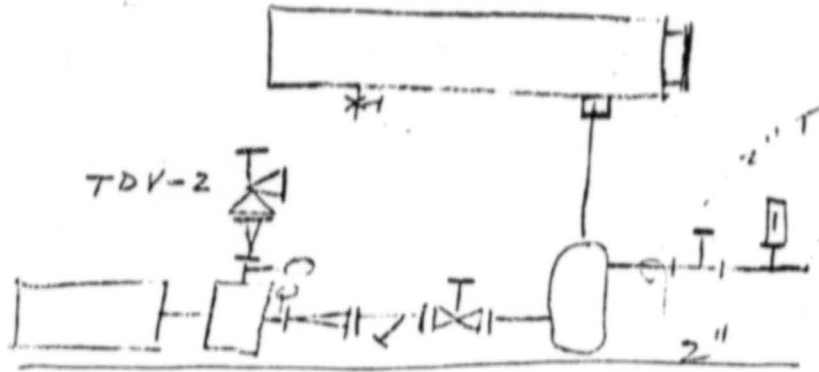
LEVEL CONTROLS  
MOTORS  
PACKAGES (CUSTOM)  
PLUMBING SPECIALTIES  
PRESSURE REGULATING  
PUMPS (ALL TYPES)  
TEMPERATURE REGULATING

THERMOMETERS  
SOLAR PRODUCTS  
STEAM SPECIALTIES  
STRAINERS  
TANKS  
VACUUM SYSTEMS  
WATER HEATERS

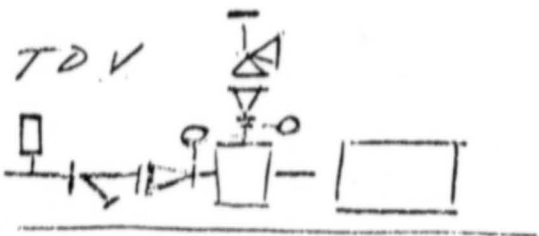
REF: Arlqtn.Racquetbl.		QU#	1081	CW#	PAGE	3	OF	4
ITEM	QTY.	DESCRIPTION			UNIT WT.	UNIT PRICE	DISC.	TOTAL PRICE
13		<u>Solar Holding Tank-</u>						
	1	John Wood Tank, commercial 100 WWP, galvanized, size 30 gallon, 12"Ø x 60", with 3 each 1" conn. 2 each 3/4" conn., & 2 each 2" conn. (less gauge glass)						
14		<u>Solar Storage Tank-</u>						
	1	John Wood 84" Ø x 180" O.L., commercial 100 WWP, painted red oxide, with manhole, one (1) 16" ) flanged conn. for HE-2 (furnished by others), one (1) 6" Ø flanged conn. for B&G TCW-684 lttx., eight 2" conn. NOTE: Zinc Chromate painting <u>not</u> included- inside of tank must be prepared and so painted in the field by others if required.			4630			
15	1	McDonnel & Miller float operated make-up valve #25A						
16	6	Man hours allowance for field alignment & Start-Up of pumps P1 & P2 (portal to portal)						
17		ADD to above price to fabricate & package pump P-1 system and pump P-2 system in accordance with attached sketch.						



Package P-1



Package P-2



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OF POOR QUALITY

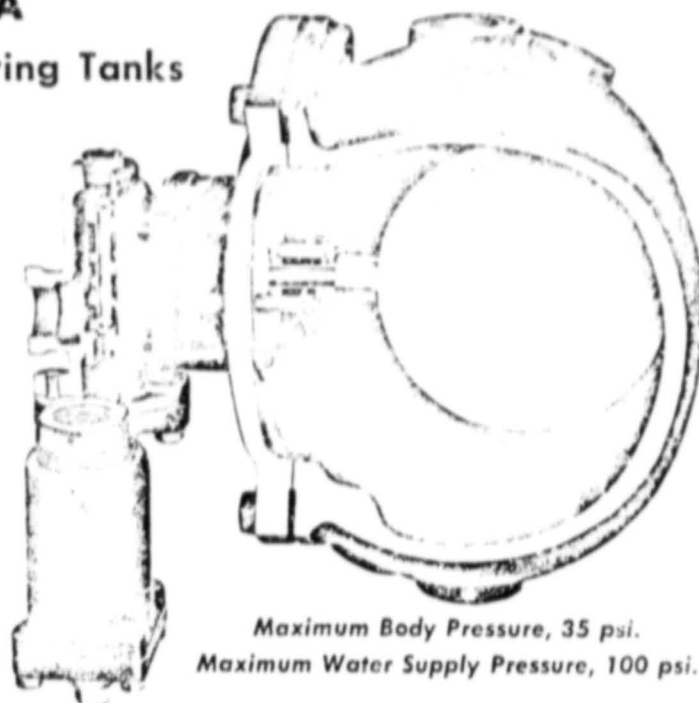
## MCDONNELL No. 25A

### Make-up Water Feeder for Receiving Tanks

The McDonnell No. 25A is a dependable float-operated feeder used to add make-up water to condensate receiving tanks whenever necessary. Its use is in keeping with the accepted modern practice of mounting a McDonnell pump controller on the boiler to keep the boiler water line within the prescribed limits for maximum efficiency. The No. 25A makes sure there is an adequate minimum supply of water in the receiver at all times to answer any demand from the boiler.

The No. 25A is mounted right along side the receiving tank, and feeds water into it through a separate feed line. It combines large feeding capacity with heavy-duty construction to meet the rugged demands of receiver tank service. Triple-feature valve design assures positive seating, as illustrated at right. Valve stem seating area is made of high temperature composition, valve seat of monel. Valve is protected by a large strainer.

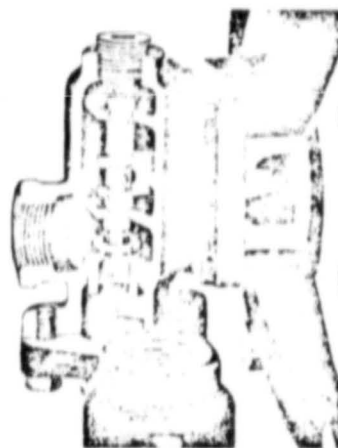
The bottom flange of this strainer housing has a removable plug. If feeder is mounted on receiver before shipment to job site, this plug permits draining water from housing after testing as a precaution against freezing; it can also be used afterward to clean out any dirt trapped by strainer.



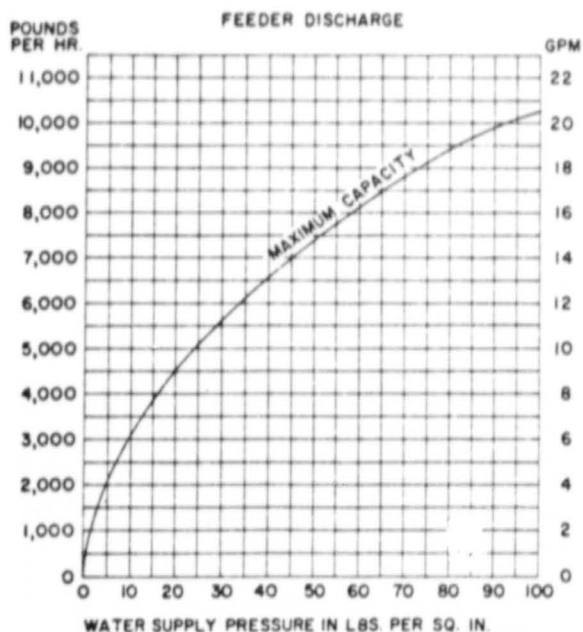
Maximum Body Pressure, 35 psi.  
Maximum Water Supply Pressure, 100 psi.

#### TRIPLE-FEATURE VALVE DESIGN

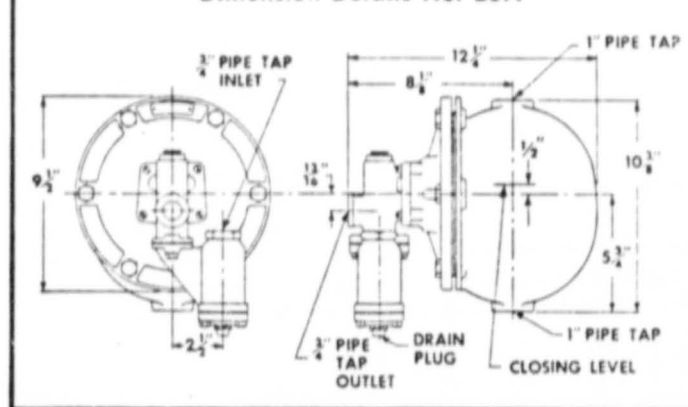
1. Cam and roller design provides straight thrust action.
2. Valve guides support valve stem at both top and bottom.
3. Stem articulates at seating area for positive valve closing.



Capacity Curve No. 25A



Dimension Details No. 25A



**MCDONNELL & MILLER ITT**

3500 N. Spaulding Avenue, Chicago, Illinois 60618

## INSTALLATION OF No. 25A MAKE-UP WATER FEEDER

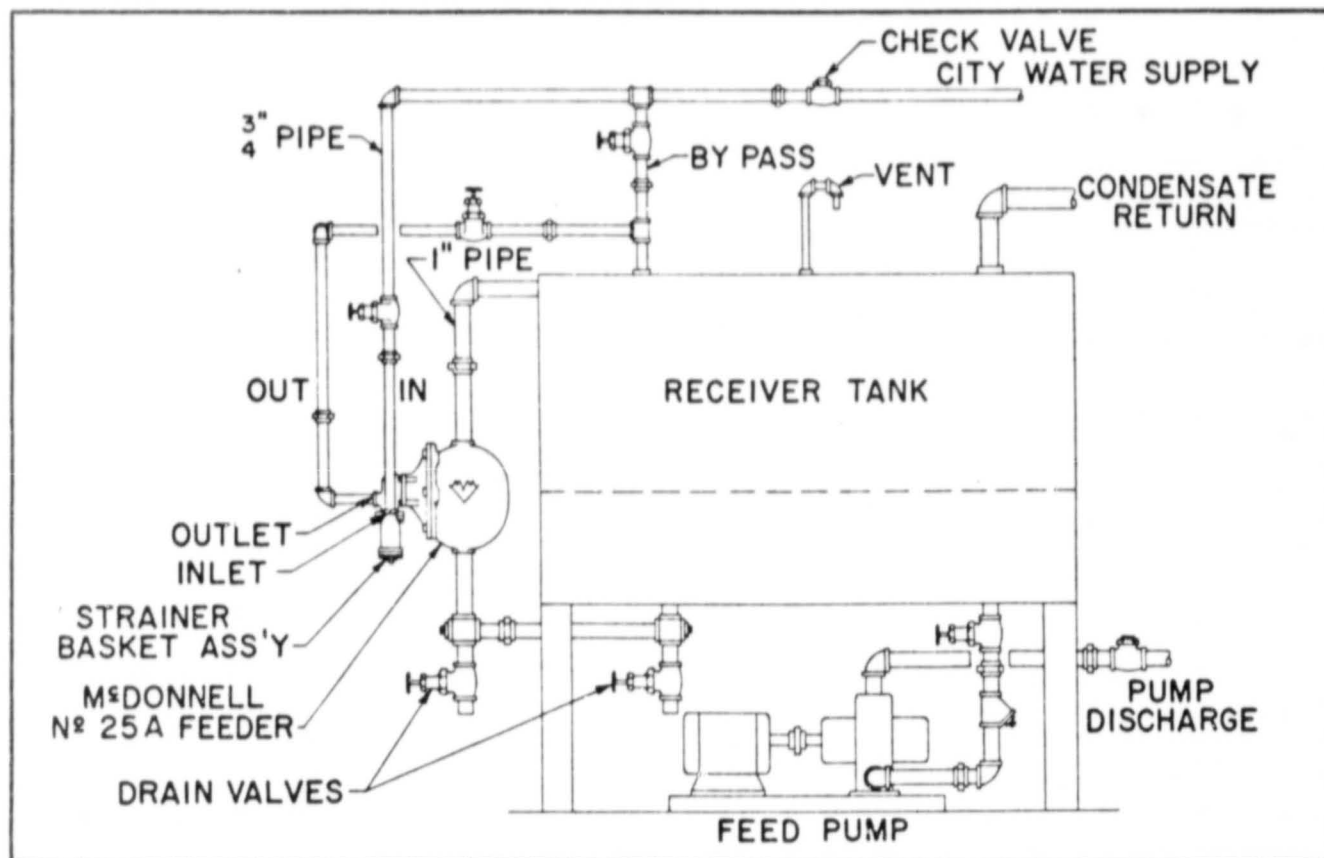
The feeder is usually located one-third of the distance from the bottom to the top of the tank. This provides ample space for return condensate.

Discharge piping from the feeder should be connected to the top of the tank. This will reduce heat transfer, keep the feed valve cool, and prevent excessive liming.

Drain valves should be located as shown in drawing

to provide blow-down for both the feeder and the tank, to flush out any sediment accumulation. A regular schedule of blow-down (once a week for example) should be maintained.

For the water equalizing piping, pipe fittings should be used which will provide access at every right angle turn. This will facilitate cleaning and assure proper equalization between the tank and the feeder.



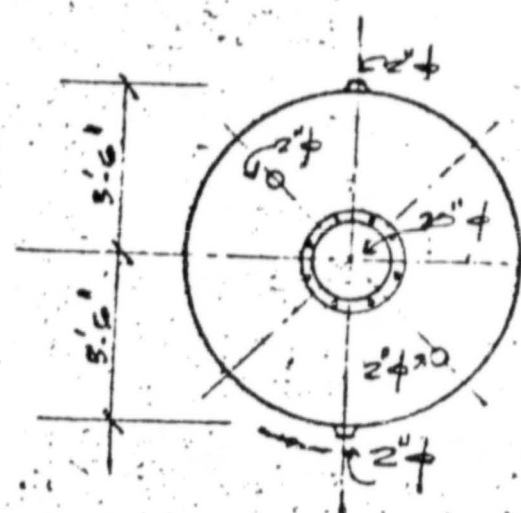
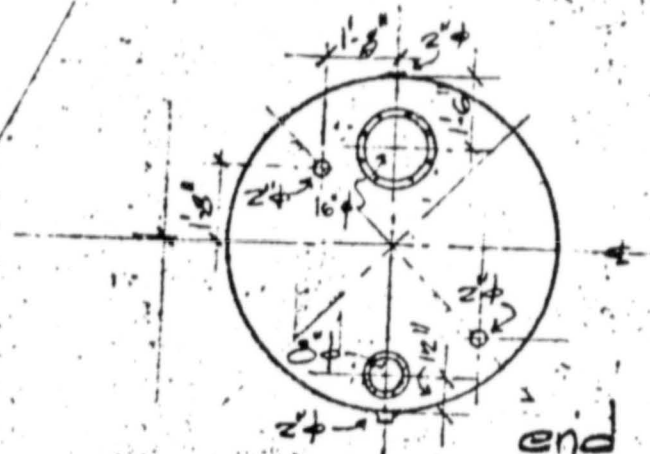
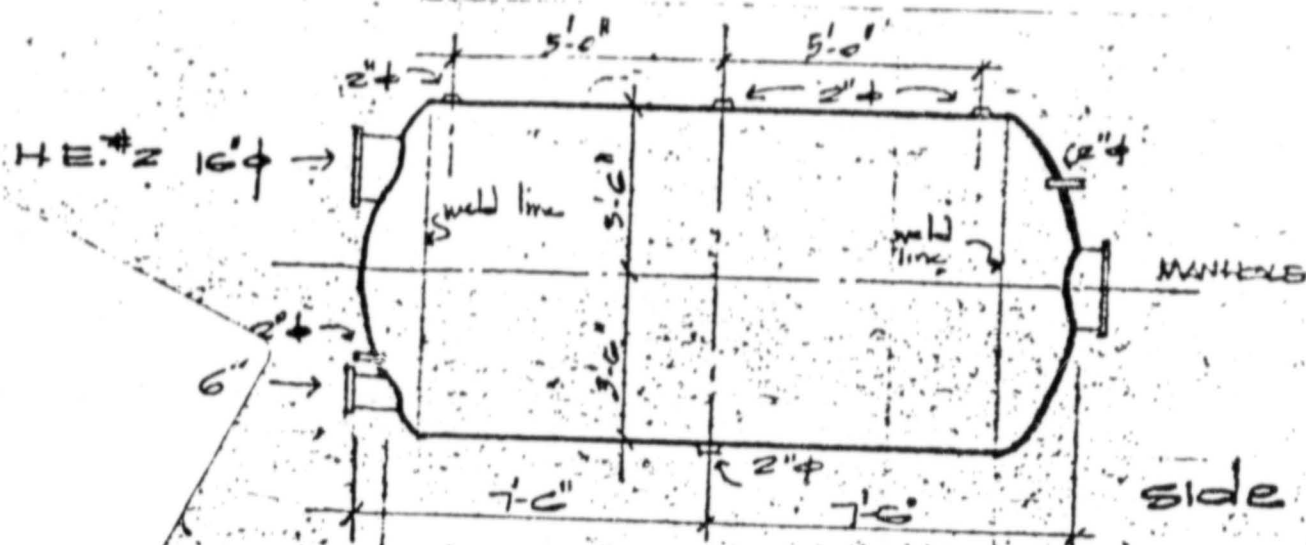
### Proper Sizing of Condensate Receivers (Reprinted from Mechanical Contractor)

"For the normal installation, it has been found customary to select a receiver of sufficient size to hold a volume equivalent to the condensate evaporated by the boiler in a one-third to one-half hour period at the normal firing rate of the boiler. For example, with a 100 H.P. boiler evaporating 3,450 lbs. of steam per hour (431.25 gallons of conden-

sate) the receiver tank should be capable of collecting (432/3) 144 gallons to (432/2) 216 gallons. Assuming 75% of the gross volume of the tank is useable, the receiver should be selected to have a gross volume of from 192 to 288 gallons, which on the average for a 100 H.P. boiler would result in a 250 gallon receiver."

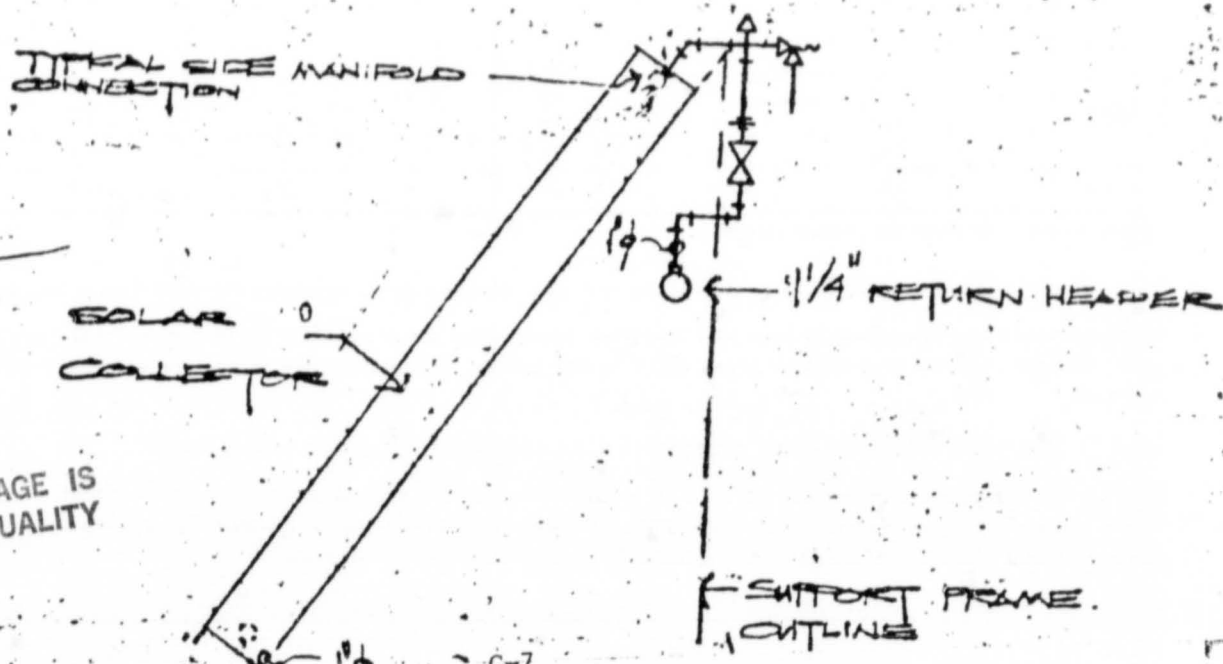
**McDONNELL & MILLER** **ITT**

3500 N. Spaulding Avenue, Chicago, Illinois 60618



detail C SOLAR STORAGE

1/4" = 1'



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SUPPORT FRAME  
OUTLINE

WOOD INDUSTRIAL PRODUCTS COMPANY  
AN ALCO STANDARD COMPANY

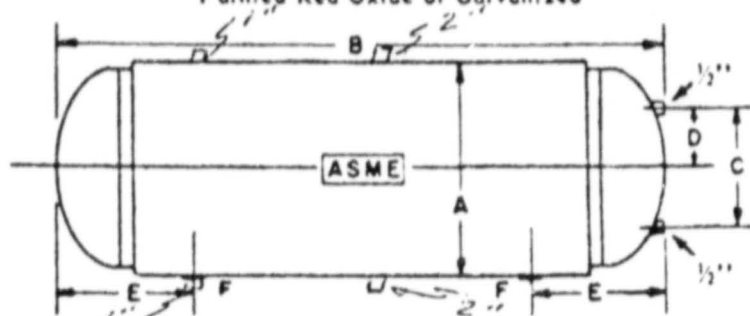


Effective February 15, 1972

Form # 713

Conshohocken, Pa.  
PHONE — 215 828 0800 TELEX — 84-6447

SPECIFICATIONS FOR  
ASME EXPANSION-COMPRESSION TANKS  
125 Lbs. Working Pressure — 188 Lbs. Test Pressure  
Painted Red Oxide or Galvanized



GAL.	A	B	C	D	E	F	WEIGHTS	
							PAINTED	GALV.
15	12"	33"	8"	4"	7 1/2"	1"	45#	50#
18	12	39	8	4	7 1/2	1	50	60
24	12	52	8	4	7 1/2	1	63	70
30	14	48	10	5	8 1/2	1	65	73
40	14	63	10	5	8 1/2	1	83	93
60	16	72	12	6	9 1/2	1	113	127
80	20	63	16	8	10	1	130	145
100	20	78	16	8	10	1	162	181
120	24	65	20	10	11 1/2	1	195	215
135	24	72	20	10	11 1/2	1	215	235
144	24	77	20	10	11 1/2	1	230	251
180	30	62 1/2	22	11	13 1/2	1 1/2	295	318
220	30	77	22	11	13 1/2	1 1/2	355	383
240	30	84	22	11	13 1/2	1 1/2	385	415
310	30	105 1/4	22	11	13 1/2	1 1/2	480	517
300	36	71 1/4	28	14	15	1 1/2	485	515
400	36	93 1/2	28	14	15	1 1/2	634	675
515	36	120 1/4	28	14	15	1 1/2	789	840
525	42	97	2 Sets	15" Ctr.	16 1/2	2	834	882
750	42	136	2 Sets	15" Ctr.	16 1/2	2	1133	1200
1000	48	129	2 Sets	15" Ctr.	17 1/2	2	1729	1814
1500	48	198	2 Sets	15" Ctr.	17 1/2	2	2319	2421
2000	48	267	2 Sets	15" Ctr.	17 1/2	2	2914	3025

\* Sizes normally in stock for prompt shipment.

Tanks are fabricated to ASME Code, subject to approval of a resident, licensed Hartford Steam Boiler Inspector.

Telltale holes are furnished in lieu of inspection opening on all sizes thru 15 to 144 gallon. Two 2" plugged inspection openings are provided on sizes 180 thru 515 gallon. 525 gallon and larger are equipped with an 11 x 15" manhole.

Taps for 2 overlapping gauge glass assemblies are included on 525 gallon size & larger.

Guarantees are against defects in material or workmanship, and are good up to the time of installation and test only. The guarantee is to the extent of the tank only, and does not include any allowance for replacement or consequential damage. Material must not be returned without first receiving our permission.



TABLE 1 - TYPE TCW (3/4" O.D. copper tubes)

BOILER WATER IN TUBES

HEATER NO.	180° PUMPED	MIN.** B.W. REQ'D.	212° PUMPED	MIN.** B.W. REQ'D.
TCW-418	10	1	22	2
TCW-424	17	1	37	3
TCW-430	27	2	54	5
TCW-436	36	3	71	6
TCW-442	46	4	90	8
TCW-448	56	5	107	9
TCW-454	67	6	126	11
TCW-460	75	6	142	12
TCW-466	86	7	160	14
TCW-472	97	8	180	15
TCW-484	107	9	199	17
TCW-496	119	10	215	18
TCW-612	0	0	29	2
TCW-618	31	3	71	6
TCW-624	58	5	121	10
TCW-630	85	7	169	14
TCW-636	114	10	224	19
TCW-642	142	12	278	24
TCW-648	173	15	332	28
TCW-654	203	17	382	32
TCW-660	233	20	438	37
TCW-666	262	22	494	42
TCW-672	295	25	545	46
TCW-684	360	31	652	55
TCW-696	421	36	763	65
TCW-818	66	6	145	12
TCW-824	110	9	228	19
TCW-830	157	13	313	27
TCW-836	207	18	405	34
TCW-842	257	22	494	42
TCW-848	319	27	602	51
TCW-854	374	32	705	60
TCW-860	430	36	810	69
TCW-866	484	41	912	77
TCW-872	534	45	1007	85
TCW-884	652	55	1204	102
TCW-896	779	66	1410	120
TCW-1024	203	17	421	36
TCW-1030	289	25	579	49
TCW-1036	382	32	748	64
TCW-1042	475	40	912	77
TCW-1048	556	47	1069	91
TCW-1054	652	55	1228	104
TCW-1060	748	64	1410	120
TCW-1066	843	72	1588	135
TCW-1072	949	81	1754	149
TCW-1084	1157	98	2096	178
TCW-1096	1356	115	2455	208
TCW-10108	1557	132	2820	239
TCW-1236	556	47	1090	93
TCW-1242	691	59	1329	113
TCW-1248	826	70	1588	135
TCW-1254	968	82	1824	155
TCW-1260	1112	94	2054	174
TCW-1266	1252	106	2314	196
TCW-1272	1383	117	2606	221
TCW-1278	1527	130	2820	239
TCW-1284	1685	143	3053	259
TCW-1296	1975	168	3577	304
TCW-12108	2268	193	4109	349
TCW-12120	2554	217	4627	393
TCW-1436	748	64	1467	125
TCW-1442	949	81	1824	155
TCW-1448	1112	94	2137	181
TCW-1454	1303	111	2504	213
TCW-1460	1497	127	2820	239
TCW-1466	1719	146	3176	270
TCW-1472	1898	161	3507	298
TCW-1478	2096	178	3872	329
TCW-1484	2268	193	4191	356
TCW-1496	2658	226	4910	417
TCW-14108	3053	259	5530	469
TCW-14120	3438	292	6227	529

MAXIMUM BOILER  
WATER CAPACITIES  
Pumped Circulation  
in TCW Units

Heater Diameter	Boiler Water In Tubes
4"	34 GPM
6"	78 GPM
8"	175 GPM
10"	310 GPM
12"	310 GPM
14"	640 GPM

Pressure drop through  
all TCW heaters at maxi-  
mum flow is approxi-  
mately .55 ft. for each  
foot of free tube length.

\*\*Minimum Boiler Water  
(BW) required is given  
in GPM (gallons per min-  
ute) based on 20° drop.  
Size piping and select  
B&G Circulating Pump  
for not less than capac-  
ity shown.



NOTE:

**TCW**

Indicates 3/4" OD Copper Tubes

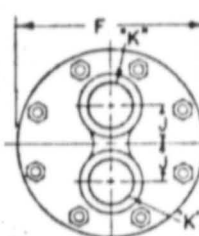
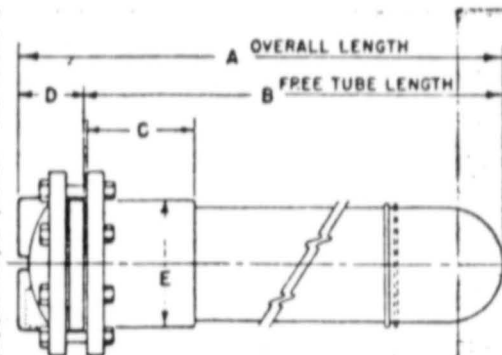
**TCS**

Indicates 3/4" OD Copper Tubes

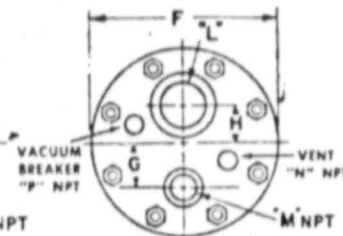
**TCY**

Indicates 1 1/4" O.D. Copper Tubes

Please indicate head and tube style when ordering.



TCW HEAD STYLE  
FOR BOILER WATER  
IN TUBES

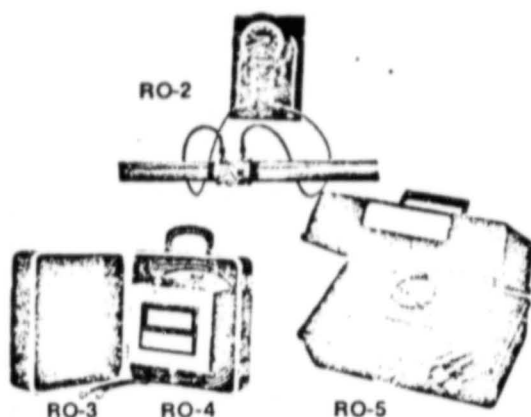


TCS OR TCY HEAD  
STYLE FOR STEAM  
IN TUBES

HEATING SURFACE SQ. FT.			A		B		C	D	E	F	G	H	J	K	L	M	N	P
HEATER NO.	TCW TCS	TCY	TCW TCS	TCY	TCW TCS	TCY												
TCW-TCS -- 412	1.0	—	13 3/4	—	11 1/4	—	6 1/8	2 11/16	4 1/2	7 1/4	1 11/16	1 3/8	1 3/8	1 1/4	1 1/4	3/4	1/2	1/4
TCW-TCS -- 418	1.8	—	19 3/4	—	17 1/4	—	6 1/8	2 11/16	4 1/2	7 1/4	1 11/16	1 3/8	1 3/8	1 1/4	1 1/4	3/4	1/2	1/4
TCW-TCS -- 424	2.5	—	25 3/4	—	23 1/4	—	6 1/8	2 11/16	4 1/2	7 1/4	1 11/16	1 3/8	1 3/8	1 1/4	1 1/4	3/4	1/2	1/4
TCW-TCS -- 430	3.3	—	31 3/4	—	29 1/4	—	6 1/8	2 11/16	4 1/2	7 1/4	1 11/16	1 3/8	1 3/8	1 1/4	1 1/4	3/4	1/2	1/4
TCW-TCS -- 436	4.1	—	37 3/4	—	35 1/4	—	6 1/8	2 11/16	4 1/2	7 1/4	1 11/16	1 3/8	1 3/8	1 1/4	1 1/4	3/4	1/2	1/4
TCW-TCS -- 442	4.9	—	43 3/4	—	41 1/4	—	6 1/8	2 11/16	4 1/2	7 1/4	1 11/16	1 3/8	1 3/8	1 1/4	1 1/4	3/4	1/2	1/4
TCW-TCS -- 448	5.7	—	49 3/4	—	47 1/4	—	6 1/8	2 11/16	4 1/2	7 1/4	1 11/16	1 3/8	1 3/8	1 1/4	1 1/4	3/4	1/2	1/4
TCW-TCS -- 454	6.5	—	55 3/4	—	53 1/4	—	6 1/8	2 11/16	4 1/2	7 1/4	1 11/16	1 3/8	1 3/8	1 1/4	1 1/4	3/4	1/2	1/4
TCW-TCS -- 460	7.2	—	61 3/4	—	59 1/4	—	6 1/8	2 11/16	4 1/2	7 1/4	1 11/16	1 3/8	1 3/8	1 1/4	1 1/4	3/4	1/2	1/4
TCW-TCS -- 466	8.0	—	67 3/4	—	65 1/4	—	6 1/8	2 11/16	4 1/2	7 1/4	1 11/16	1 3/8	1 3/8	1 1/4	1 1/4	3/4	1/2	1/4
TCW-TCS -- 472	8.8	—	73 3/4	—	71 1/4	—	6 1/8	2 11/16	4 1/2	7 1/4	1 11/16	1 3/8	1 3/8	1 1/4	1 1/4	3/4	1/2	1/4
TCW-TCS -- 484	9.6	—	85 3/4	—	83 1/4	—	6 1/8	2 11/16	4 1/2	7 1/4	1 11/16	1 3/8	1 3/8	1 1/4	1 1/4	3/4	1/2	1/4
TCW-TCS -- 496	10.4	—	97 3/4	—	95 1/4	—	6 1/8	2 11/16	4 1/2	7 1/4	1 11/16	1 3/8	1 3/8	1 1/4	1 1/4	3/4	1/2	1/4
TCW-TCS -- 612	3.3	—	12 1/2	—	9 3/4	—	6 1/8	3 1/2	6 5/8	10 1/2	2 5/8	1 7/8	1 7/8	2	2	1	1/2	1/2
TCW-TCS -- 618	5.6	—	18 1/2	—	15 3/4	—	6 1/8	3 1/2	6 5/8	10 1/2	2 5/8	1 7/8	1 7/8	2	2	1	1/2	1/2
TCW-TCS-TCY-624	8.0	6.1	24 1/2	26 3/4	21 3/4	24	6 1/8	3 1/2	6 5/8	10 1/2	2 5/8	1 7/8	1 7/8	2	2	1	1/2	1/2
TCW-TCS-TCY-630	10.3	7.8	30 1/2	32 3/4	27 3/4	30	6 1/8	3 1/2	6 5/8	10 1/2	2 5/8	1 7/8	1 7/8	2	2	1	1/2	1/2
TCW-TCS-TCY-636	12.7	9.4	36 1/2	38 3/4	33 3/4	36	6 1/8	3 1/2	6 5/8	10 1/2	2 5/8	1 7/8	1 7/8	2	2	1	1/2	1/2
TCW-TCS-TCY-642	15.0	11.0	42 1/2	44 3/4	39 3/4	42	6 1/8	3 1/2	6 5/8	10 1/2	2 5/8	1 7/8	1 7/8	2	2	1	1/2	1/2
TCW-TCS-TCY-648	17.4	12.6	48 1/2	50 3/4	45 3/4	48	6 1/8	3 1/2	6 5/8	10 1/2	2 5/8	1 7/8	1 7/8	2	2	1	1/2	1/2
TCW-TCS-TCY-654	19.7	14.3	54 1/2	56 3/4	51 3/4	54	6 1/8	3 1/2	6 5/8	10 1/2	2 5/8	1 7/8	1 7/8	2	2	1	1/2	1/2
TCW-TCS-TCY-660	22.1	16.0	60 1/2	62 3/4	57 3/4	60	6 1/8	3 1/2	6 5/8	10 1/2	2 5/8	1 7/8	1 7/8	2	2	1	1/2	1/2
TCW-TCS-TCY-666	24.4	17.5	66 1/2	68 3/4	63 3/4	66	6 1/8	3 1/2	6 5/8	10 1/2	2 5/8	1 7/8	1 7/8	2	2	1	1/2	1/2
TCW-TCS-TCY-672	26.8	19.2	72 1/2	74 3/4	69 3/4	72	6 1/8	3 1/2	6 5/8	10 1/2	2 5/8	1 7/8	1 7/8	2	2	1	1/2	1/2
TCW-TCS-TCY-684	31.5	22.4	84 1/2	86 3/4	81 3/4	84	6 1/8	3 1/2	6 5/8	10 1/2	2 5/8	1 7/8	1 7/8	2	2	1	1/2	1/2
TCW-TCS-TCY-696	36.2	25.7	96 1/2	98 3/4	93 3/4	96	6 1/8	3 1/2	6 5/8	10 1/2	2 5/8	1 7/8	1 7/8	2	2	1	1/2	1/2
TCW-TCS -- 818	11	—	20 1/4	—	16 1/4	—	8	4	8 5/8	12 1/2	3 3/8	2 1/4	2 1/2	3	3	1 1/4	1/2	1/2
TCW-TCS-TCY-824	15	11	26 1/4	27 3/4	22 1/4	24	8	4	8 5/8	12 1/2	3 3/8	2 1/4	2 1/2	3	3	1 1/4	1/2	1/2
TCW-TCS-TCY-830	19	14	32 1/4	33 3/4	28 1/4	30	8	4	8 5/8	12 1/2	3 3/8	2 1/4	2 1/2	3	3	1 1/4	1/2	1/2
TCW-TCS-TCY-836	23	17	38 1/4	39 3/4	34 1/4	36	8	4	8 5/8	12 1/2	3 3/8	2 1/4	2 1/2	3	3	1 1/4	1/2	1/2
TCW-TCS-TCY-842	27	20	44 1/4	45 3/4	40 1/4	42	8	4	8 5/8	12 1/2	3 3/8	2 1/4	2 1/2	3	3	1 1/4	1/2	1/2
TCW-TCS-TCY-848	32	23	50 1/4	51 3/4	46 1/4	48	8	4	8 5/8	12 1/2	3 3/8	2 1/4	2 1/2	3	3	1 1/4	1/2	1/2
TCW-TCS-TCY-854	36.5	26	56 1/4	57 3/4	52 1/4	54	8	4	8 5/8	12 1/2	3 3/8	2 1/4	2 1/2	3	3	1 1/4	1/2	1/2
TCW-TCS-TCY-860	41	29	62 1/4	63 3/4	58 1/4	60	8	4	8 5/8	12 1/2	3 3/8	2 1/4	2 1/2	3	3	1 1/4	1/2	1/2
TCW-TCS-TCY-866	45	32	68 1/4	69 3/4	64 1/4	66	8	4	8 5/8	12 1/2	3 3/8	2 1/4	2 1/2	3	3	1 1/4	1/2	1/2
TCW-TCS-TCY-872	49	35	74 1/4	75 3/4	70 1/4	72	8	4	8 5/8	12 1/2	3 3/8	2 1/4	2 1/2	3	3	1 1/4	1/2	1/2
TCW-TCS-TCY-884	58	40	86 1/4	87 3/4	82 1/4	84	8	4	8 5/8	12 1/2	3 3/8	2 1/4	2 1/2	3	3	1 1/4	1/2	1/2
TCW-TCS-TCY-896	67	46	98 1/4	99 3/4	94 1/4	96	8	4	8 5/8	12 1/2	3 3/8	2 1/4	2 1/2	3	3	1 1/4	1/2	1/2

**SUBMITTAL**

A-552  
REVISION 3



# Engineered Products Read Out Kits

JOB <u>ARlington Racquetball Ct.</u>		B & G REPRESENTATIVE <u>Cummins-Wagner</u>	
UNIT TAG NO. _____	ORDER NO. _____	DATE _____	
ENGINEER _____	SUBMITTED BY <u>Wally Bass</u>	DATE <u>12/14/78</u>	
CONTRACTOR <u>Rust Construction</u>	APPROVED BY _____	DATE _____	

## DESCRIPTION

B&G Readout Kits are designed for use with B&G Circuit Setter Balance Valves and Circuit Sensor Flow Meters. They may also be used to check differential pressures across other system components including B&G pumps,

Suction Diffusers, strainers, coils, etc. All readout kits feature full overrange protection and are equipped with hoses, readout probes, carrying case and Circuit Setter Balance Valve calculator.

MODEL NO.	OVERALL CASE DIMENSIONS			MINIMUM DIFFERENTIAL	READING RANGE	% OF ACCURACY	QUANTITY	TAGGING INFORMATION
	LENGTH	WIDTH	HEIGHT					
RO-2	14"	9½"	7"	.5'	.5'-100'	±.5%		
RO-3	13"	12"	8"		.5'-16'	±1%		
RO-4					.5'-35'			
RO-5	12¼"	6¾"	6"		.5'-25'	±3%		

Maximum Operating Conditions  
Working Pressure: 250 PSI  
Temperature: 250°F

Note: For other pressures or ranges, consult factory.  
\*Full Scale Accuracy.

## TYPICAL SPECIFICATION

Provide a portable Readout Meter with provision for hanging, capable of indicating pressure differential across a system component. Unit to be complete with all necessary

hoses, shut-off and vent valves, and carrying case. Reading range to be \_\_\_\_\_. Read Out Kits to be ITT Bell & Gossett Model #\_\_\_\_\_.



BELL & GOSSETT  
PRODUCTS

SUBMITTAL 1 OF 1

REVISION 2

In-Line Mounted Centrifugal Pumps

SERIES "60"

1 1/4 AA



JOB Arlington Racquetball Court

UNIT TAG NO. \_\_\_\_\_

ENGINEER \_\_\_\_\_

CONTRACTOR Rust Construction

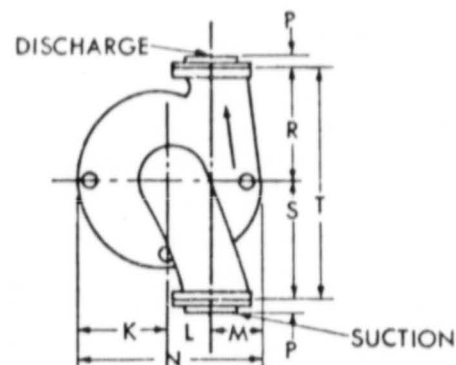
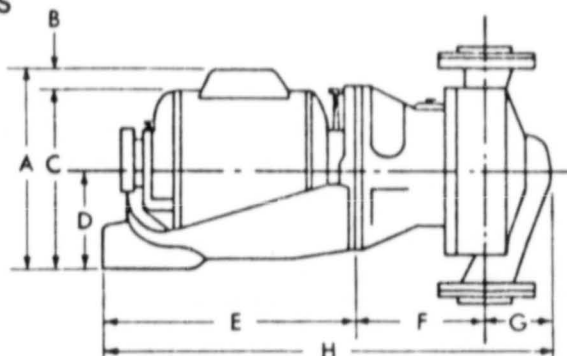
B & G REPRESENTATIVE Cummins-Wagner

ORDER NO. \_\_\_\_\_ DATE \_\_\_\_\_

SUBMITTED BY Wally Bass DATE 12/14/7

APPROVED BY \_\_\_\_\_ DATE \_\_\_\_\_

### DIMENSIONS



Companion Flanges furnished for Suction and Discharge

PUMP SIZE	SUCTION AND DISCHARGE SIZE— INCHES NPT	PUMP DIMENSIONS—INCHES									
		F	G	K	L	M	N	P	R	S	T
1 1/4 AA	1 1/4	5 1/4	3 3/4	3 3/4	1 1/4	2 1/2	7 1/2	3/4	5	6	11

ALL MOTORS 1750 RPM

MOTOR SIZE		MOTOR DIMENSIONS—INCHES					
H.P.	PHASE	A	B	C	D	E	H
1/4	1	7 3/4	—	7 3/4	4 3/4	10	19 1/4
1/4	3	7 3/4	—	7 3/4	4 3/4	9 3/4	19
1/2	1	9 1/2	2 1/4	7 3/4	4 3/4	11	20 3/4
1/2	3	7 3/4	—	7 3/4	4 3/4	11	20 3/4
1/2	1	9 1/2	2 1/4	7 3/4	4 3/4	11 1/2	20 3/4
1/2	3	7 3/4	—	7 3/4	4 3/4	11	20 3/4

### SPECIAL INFORMATION REQUIRED

7 GPM 25 FT.

MATERIALS OF CONSTRUCTION:

☒ BRONZE FITTED ☐ ALL IRON ☐ ALL BRONZE

ELECTRICAL DATA: 1/4 HP

115 VOLTS 60 CY. 1 PH.

MOTOR ENCL. 00

SPEC. CONSTR.

MAXIMUM WORKING PRESSURE 175 PSI

SEE PERFORMANCE CURVE ON REVERSE SIDE

BELL & GOSSETT MORTON GROVE, ILL. 60053

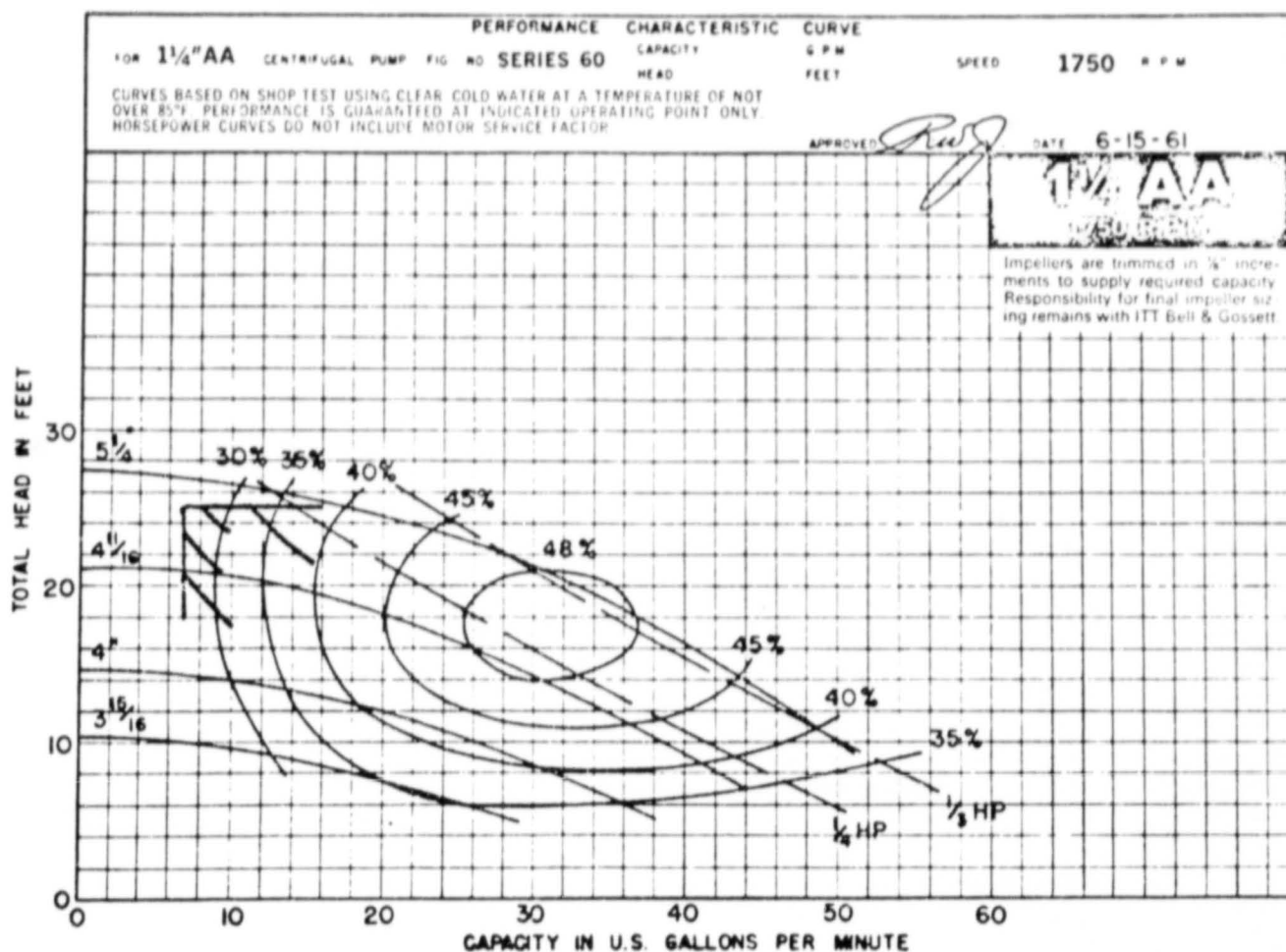
Fluid Handling Division, International Telephone and Telegraph Corporation



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PRINTED IN U.S.A. 10 72

# SERIES "60" PERFORMANCE CURVES



BELL & GOSSETT MORTON GROVE, ILL. 60053 **ITT**  
 Fluid Handling Division, International Telephone and Telegraph Corporation

B-224.6  
REVISION 4

# 1 1/4 BB SERIES 1510 Centrifugal Pumps – Base Mounted

JOB Arlington Racquetball Ct.

B & G REPRESENTATIVE CUMMINS-WAGNER

UNIT TAG NO. \_\_\_\_\_

ORDER NO. \_\_\_\_\_

DATE \_\_\_\_\_

ENGINEER \_\_\_\_\_

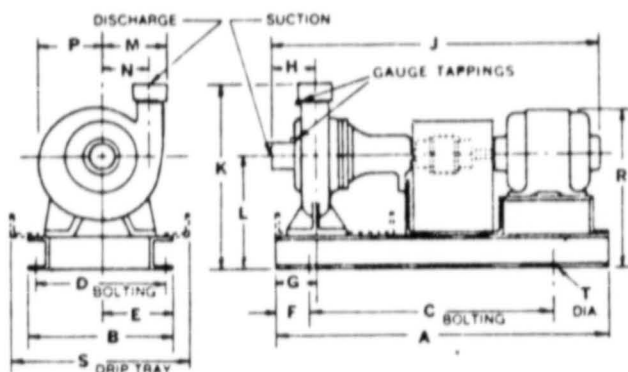
SUBMITTED BY Wally Bass

DATE 1/2/14/78

CONTRACTOR Rust Construction

APPROVED BY \_\_\_\_\_

DATE \_\_\_\_\_



## SPECIFICATIONS

30 GPM 60 FT.

MATERIALS OF CONSTRUCTION:

☒ BRONZE FITTED ☐ ALL IRON ☐ ALL BRONZE

ELECTRICAL DATA 2 HP

208 VOLTS 60 CY 3 PH

MOTOR ENCL. 00

SPEC. CONSTR. \_\_\_\_\_

APPROXIMATE WEIGHT 177 LBS

☒ 1510 (Standard Seal)

☐ 1510-PF

(Packing—Flushed)

☐ 1510-S (Single Seal)

☐ 1510-D (Double Seal)

MAXIMUM WORKING  
PRESSURE 175 PSI

## DIMENSIONS

### STANDARD SEAL 1510

PUMP SIZE & DISCHARGE	SUCTION SIZE	MOTOR FRAME	PUMP DIMENSIONS (INCHES)																
			A	B	C	D	E	F	G	H	J (Max.)	K	L	M	N	P	R (Max.)	S	T
			"S" FRAME																
1¼BB N.P.T.	1½" N.P.T.	143T									28⅞						14½	13¾	¾
		145T	31	14⅞	25	12⅞	7⅞	3	4⅞	2⅞	29⅞	18¾	10¾	6⅞	5½	5⅞	16		
		182T									31⅞								
		184T									32⅞								
	"L" FRAME																		
	213T	39⅞	14⅞	33⅞	12⅞	7⅞	3	4⅞		39½	18¾	10¾				16⅞		¾	
	215T									41									
	254T									44¾	20	12	6⅞	5½	5⅞	18⅞	13¾		
	256T	46½	16	36½	14	8	5	5⅞	2⅞	46½								⅞	
	284TS									45¾	21	13				21			
	286TS									47¼									

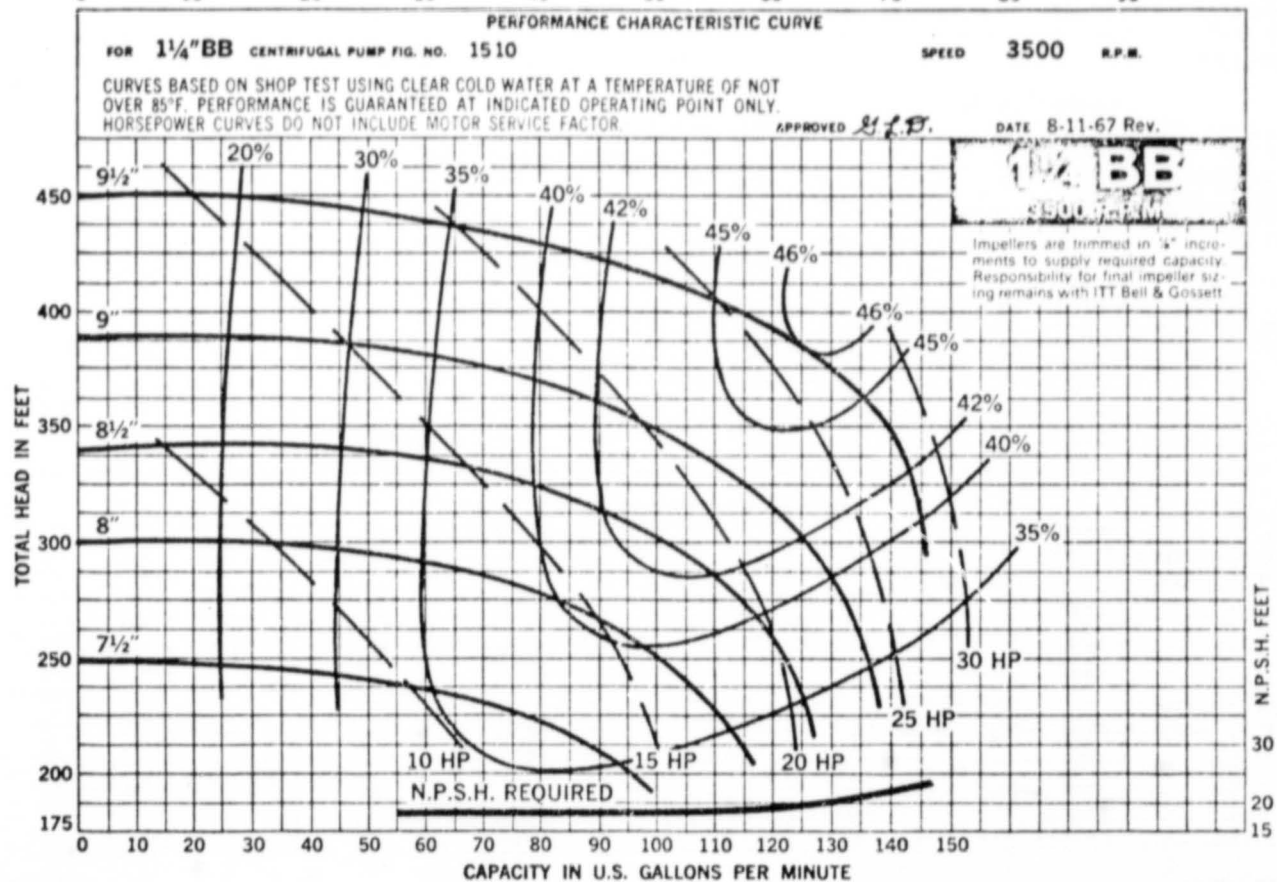
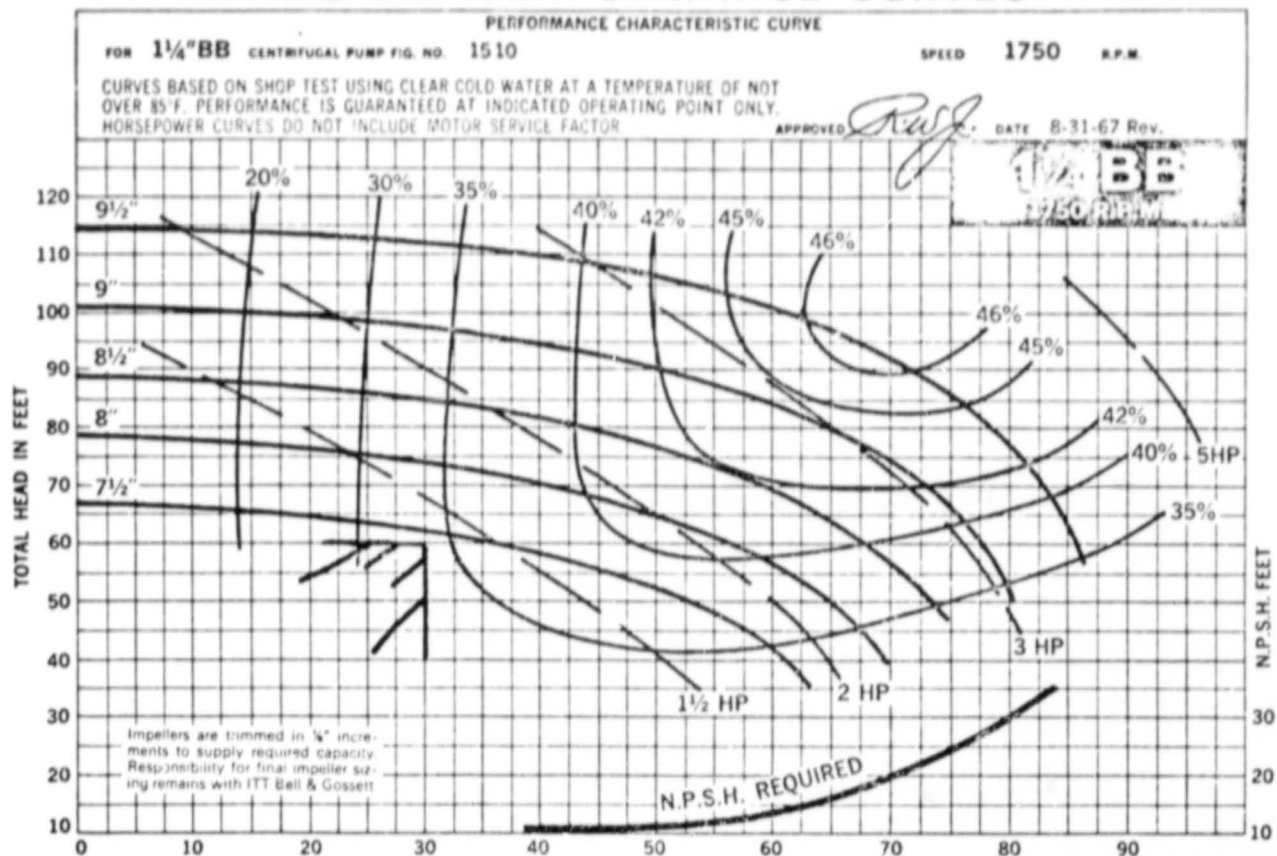
### STUFFING BOX 1510-PF, 1510-S, 1510-D

PUMP SIZE & DISCHARGE	SUCTION SIZE	MOTOR FRAME	PUMP DIMENSIONS (INCHES)																	
			A	B	C	D	E	F	G	H	J (Max.)	K	L	M	N	P	R (Max.)	S	T	
			"S" FRAME																	
1¼BB N.P.T.	1½" N.P.T.	143T									31¾						14½	13¾	¾	
		145T	34⅞	14⅞	28⅞	12⅞	7⅞	3	4⅞	2⅞	32⅞	18¾	10¾	6¾	5½	5⅞	16			
		182T									35⅞									
		184T									36⅞									
		"L" FRAME																		
		213T	46½		36½						41⅞						17⅞			
		215T									43⅞									
		254T									47⅞	20	12		6¾	5½	5⅞	18⅞	13¾	¾
		256T	51¼	16	41¼	14	8	5	5⅞	2⅞	48⅞									
		284TS									48¼	21	13					21		
		286TS									49¼									

**BELL & GOSSETT** **ITT**  
FLUID HANDLING DIVISION



# 1010 PERFORMANCE CURVES



PRINTED IN U.S.A. 5-78

**BELL & GOSSETT** **ITT**  
 8200 N. AUSTIN AVE. • MORTON GROVE, ILL. 60053  
 INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION





# 1 1/4 BB SERIES 1510 Centrifugal Pumps – Base Mounted

SUBMITTAL

B-224.6  
REVISION 4

JOB Arlington Racquetball Ct.

B & G REPRESENTATIVE Cummins-Wagner Co., Inc.

UNIT TAG NO. \_\_\_\_\_

ORDER NO. \_\_\_\_\_

DATE \_\_\_\_\_

ENGINEER \_\_\_\_\_

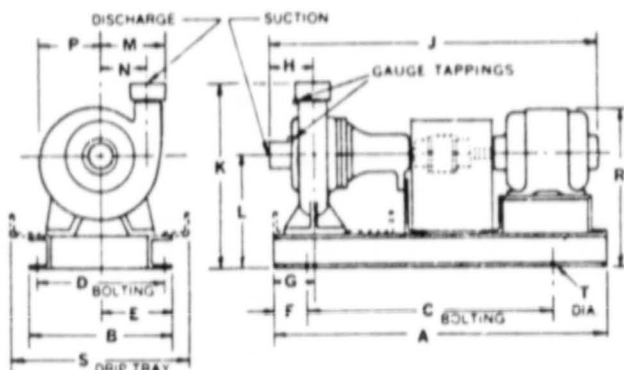
SUBMITTED BY Wally Bass

DATE 12/14/78

CONTRACTOR Rust Construction

APPROVED BY \_\_\_\_\_

DATE \_\_\_\_\_



## SPECIFICATIONS

60 GPM 70 FT

MATERIALS OF CONSTRUCTION

☒ BRONZE FITTED ☐ ALL IRON ☐ ALL BRONZE

ELECTRICAL DATA 3 HP

208 VOLTS 60 CY 3 PH

MOTOR ENCL 00

SPEC CONSTR \_\_\_\_\_

APPROXIMATE WEIGHT 196 LBS

☒ 1510 (Standard Seal)

☐ 1510-PF

(Packing—Flushed)


☐ 1510-S (Single Seal)

☐ 1510-D (Double Seal)

MAXIMUM WORKING  
PRESSURE 175 PSI

## DIMENSIONS

### STANDARD SEAL 1510

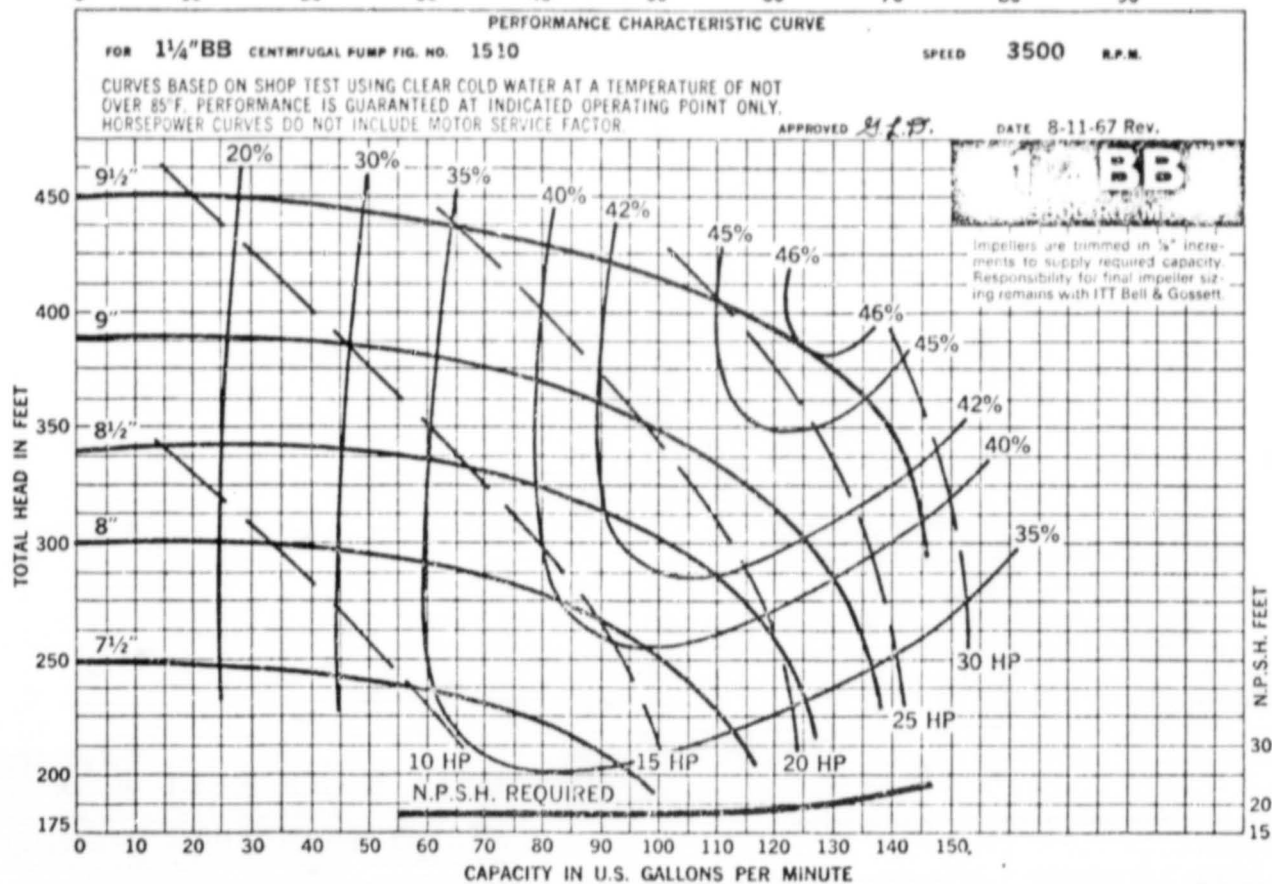
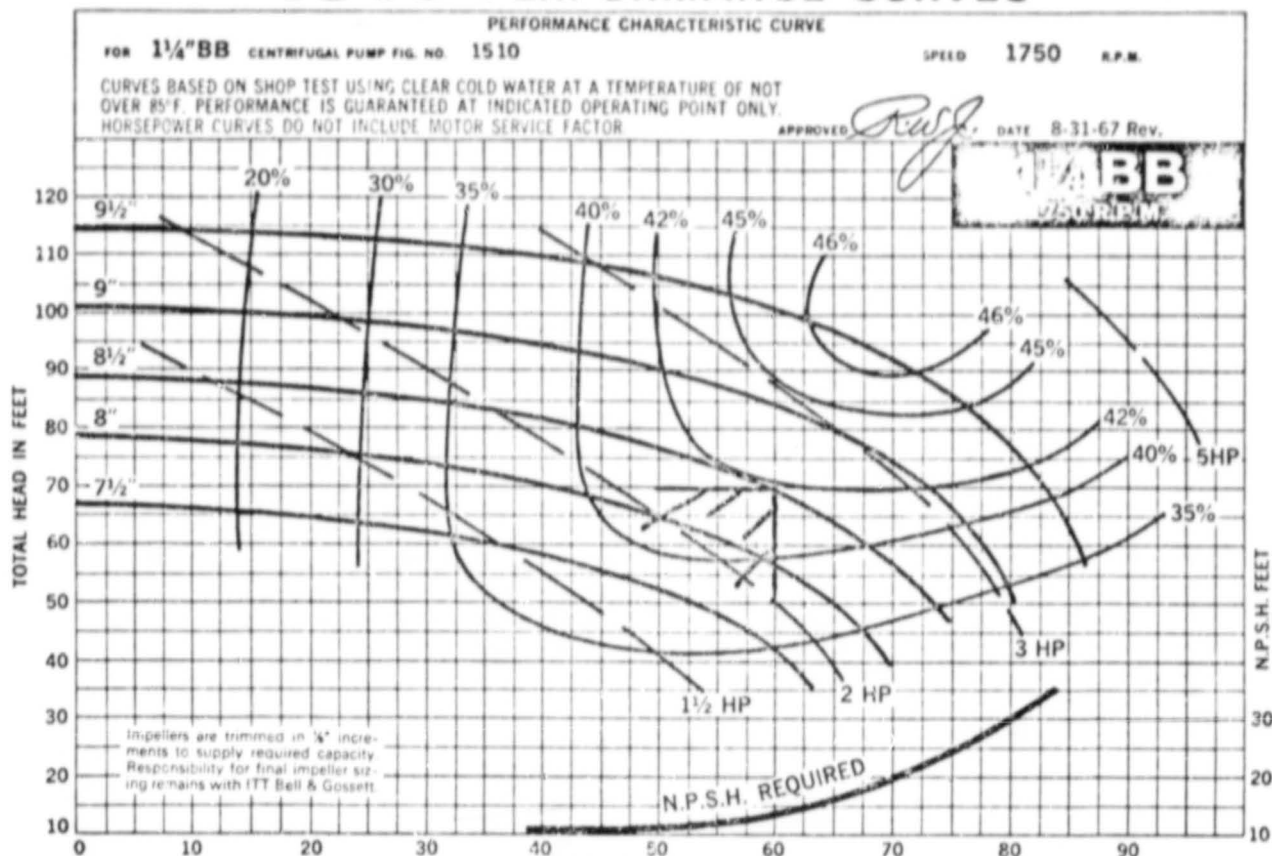
PUMP SIZE & DISCHARGE	SUCTION SIZE	MOTOR FRAME	PUMP DIMENSIONS (INCHES)																
		A	B	C	D	E	F	G	H	J (Max)	K	L	M	N	P	R (Max)	S	T	
		"S" FRAME																	
1 1/4 BB N.P.T.		143T	31	14 1/8	25	12 3/8	7 1/4	3	4 1/4	2 1/4	28 1/8	18 3/4	10 3/4	6 3/4	5 1/2	5 1/4	14 1/2	13 3/4	3/4
		145T									29 1/8						16		
		182T									31 1/8								
		184T									32 1/8								
	"L" FRAME																		
	213T	39 3/8	14 1/8	33 3/8	12 3/8	7 1/4	3	4 1/4		39 1/2	18 3/4	10 3/4	6 3/4	5 1/2	5 1/4	16 3/8	13 3/4	3/4	
	215T								41										
	254T								44 1/4	20	12								
	256T	46 1/2	16	36 1/2	14	8	5	5 1/4	2 1/4	46 1/2									18 3/8
	284TS									45 3/4	21	13				21			
	286TS									47 1/4									

### STUFFING BOX 1510-PF, 1510-S, 1510-D

PUMP SIZE & DISCHARGE	SUCTION SIZE	MOTOR FRAME	PUMP DIMENSIONS (INCHES)																
			A	B	C	D	E	F	G	H	J (Max)	K	L	M	N	P	R (Max)	S	T
			"S" FRAME																
1¼BB N.P.T.	1½" N.P.T.	143T	34⅞	14⅞	28⅞	12⅞	7⅞	3	4⅞	2⅞	31⅞	18⅞	10⅞	6⅞	5½	5⅞	14½	13⅞	¾
		145T									32⅞						14½		
		182T									35⅞						16		
		184T									36⅞								
		"L" FRAME																	
		213T	46½	16	36½	14	8	5	5⅞	2⅞	41⅞	20	12	6⅞	5½	5⅞	17⅞	13⅞	¾
		215T	43⅞		18⅞														
		254T	47⅞		21														
		256T	48⅞		21														
		284TS	48¼		21														
		286TS	49¼		21														

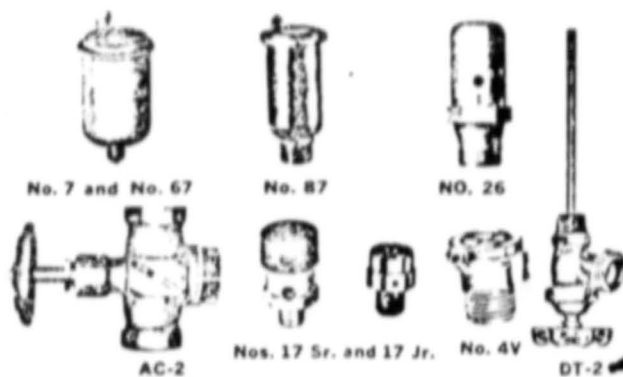
BELL & GOSSETT **ITT**  
FLUID HANDLING DIVISION

# 1510 PERFORMANCE CURVES



**SUBMITTAL**

A-338  
REVISION 6



# MISCELLANEOUS AIR HANDLING ACCESSORIES - AIR CHARGER - DRAIN-O-TANK® - AIR VENTS

JOB <u>Arlington Racquetball</u>		B & G REPRESENTATIVE <u>Cummins-Wagner Co.</u>	
UNIT TAG NO. _____	ORDER NO. _____	DATE _____	
ENGINEER _____	SUBMITTED BY <u>Wally Bass</u>	DATE <u>12/14/78</u>	
CONTRACTOR <u>Rust Construction</u>	APPROVED BY _____	DATE _____	

## DESCRIPTION

Both the *Air Charger* and *Drain-O-Tank* will admit air to the compression tank and drain water. However, the *Air Charger* is a 3-way valve which also closes off the system. Air tube and piping not furnished with air charger.

The No. 17 Jr. and Sr. valves are primarily for radiation. Only the Sr. has a manual control. The No. 67 and No. 7 vents have built-in air chambers. The No. 7 and No. 87 are heavy duty

units. An overflow connector for 1/4" O.D. copper tubing can be furnished for No. 7, No. 67 and No. 87 vents. The 4V air vent is specially designed for new type radiators. The No. 26 Vacuum Breaker controls induced vacuum within a manually adjustable range of 1/4" to 20" of Mercury.

**CONSTRUCTION** Bodies—Brass  
Internals—All Non Ferrous

## SCHEDULE

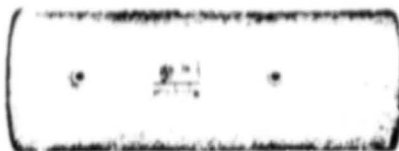
MODEL NO.	PRODUCT	MAXIMUM		TAGGING INFORMATION	QUANTITY
		WORKING PRESSURE P.S.I.G.	OPERATING TEMPERATURE °F		
4V	Air Vent	150	225		
67	Automatic Air Vent	35	240		
7		75			
87		150			
17 Jr.	Automatic	35	225		
17 Sr.	Hot Water Air Valve	30			
26	Vacuum Breaker	150	250		
AC-2	Air Charger & Tank Drain	125	240		
DT-2	Drain-O-Tank				

## DIMENSIONS & WEIGHTS

MODEL NO.	DIMENSIONS (INCHES)		CONNECTION NPT. SIZE INCHES		APPROXIMATE SHIPPING WEIGHT—LBS.		
	WIDTH	HEIGHT			EACH	CARTON OF	
4V	5/8	5/8	1/8	M	—	48	1 1/2
7	2 1/4	4 1/4		F		6	
87	2 1/4	4 3/4	1/2	F	3/4	12	8
			3/4	M			1 1/2
17 Jr.	1 1/4	1	1/8	M	—		2
17 Sr.	1 1/4	1 1/4					3
67	1 1/2	3 3/4					2 1/4
26	1 1/4	3					1/2
AC-2	4 3/8	3 3/4	M	1	12	8	
DT-2	2 1/4	9 3/4					

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**BELL & GOSSETT** **ITT**  
8200 N. AUSTIN AVE. - MORTON GROVE, ILL. 60053  
**FLUID HANDLING DIVISION**  
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION



# ASME Compression Tanks Air Control

JOB Arlington Racquetball ct.

B &amp; G REPRESENTATIVE Cummins-Wagner Co., Inc.

UNIT TAG NO. \_\_\_\_\_

ORDER NO. \_\_\_\_\_

DATE \_\_\_\_\_

ENGINEER \_\_\_\_\_

SUBMITTED BY Wally Bass

DATE 12/14/78

CONTRACTOR Rust Construction

APPROVED BY \_\_\_\_\_

DATE \_\_\_\_\_

**DESCRIPTION**

The Compression Tank absorbs the expansion forces of the system water and provides proper pressurization under varying operating conditions. Used with Airtrol Fittings it provides positive air control, by accepting and confining all free air in the system.

**CONSTRUCTION**

Carbon steel with two 1/2" gauge glass tappings and four 3/16" diameter telltale holes (approved by the A.S.M.E. Pressure Vessel Code) on the shells. Constructed in accordance with ASME and so stamped.

**PERFORMANCE LIMITATIONS**

Maximum Design Pressure 125 PSIG  
Maximum Design Temperature 375 F

**SCHEDULE**

MODEL NO. AND GALLON CAPACITY	REQUIRED AIRTROL TANK FITTING	TAGGING INFORMATION	QUANTITY
15	ATF-12		
24			
30			1
40	ATF-16		
60			
80			
100	ATFL		
120			
144			
163			
202			
238			
270			
306			
337			
388			

**TYPICAL SPECIFICATION**

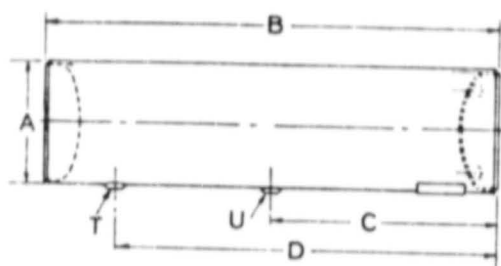
Furnish and install as shown on the plans a \_\_\_\_\_ gallon, \_\_\_\_\_ " X \_\_\_\_\_ " compression tank with 1/2" gauge glass tappings. The unit must be constructed in accordance with A.S.M.E. boiler and pressure vessel code and stamped 125 PSIG design pressure.

A Manufacturers' Data Report for Pressure Vessels, Form U-1 as required by the provisions of the A.S.M.E. boiler and pressure code shall be furnished with each unit upon request.

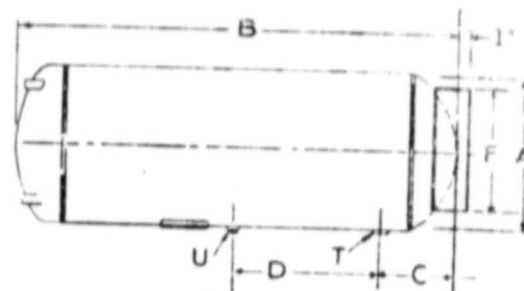
Each compression tank shall be ITT Bell & Gossett Model No. \_\_\_\_\_ or equal.

**BELL & GOSSETT ITT**  
FLUID HANDLING DIVISION

## ASME COMPRESSION TANKS (Air Control)



Nos. 15 thru 144



Nos. 163 thru 388

### DIMENSIONS & WEIGHTS

MODEL NUMBER	DIMENSIONS IN INCHES						TAPPINGS NPT			APPROX. SHIP. WGT.—LBS.
	A	B	C	D	E	F	T	U	W	
15	13	34½	17¼	24¾	7½	N/A	½	½	½	63
24		51	25½	38						86
30		61½	30¾	46¼						99
40	16¼	53	26½	39¼	10					119
60		76½	38¾	58						157
80	20¼	68	34	50¾	14					205
100		82	41	61¼						236
120	24¼	71½	35¾	53¼	18					267
144		83½	41¾	62¾						298
163	30	60	13⅞	16⅞	24	27	½	1	½	396
202		72		22⅞						456
238		84		28⅞						515
270		96		34⅞						574
306		108		40⅞						633
337	36	84	14¾	27⅝	30	30½				599
388		96		33⅝						669

N/A - Not Applicable





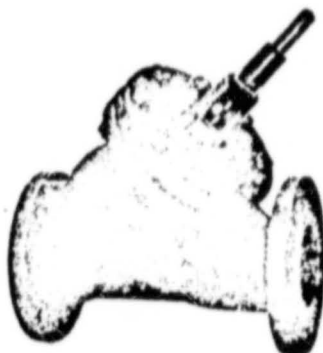
BELL & GOSSETT  
PRODUCTS

AND SUBMITTAL SHEET

REVISION 2

Engineered Products

## STRAIGHT TRIPLE DUTY CHECK VALVE



JOB Arlington Racquetball Ct.

ENGINEER \_\_\_\_\_

CONTRACTOR Rust Construction

B & G REPRESENTATIVE Cummins-Wagner Co.

ORDER NO. \_\_\_\_\_ DATE \_\_\_\_\_

SUBMITTED BY Wally Bass DATE 12/14/78

APPROVED BY \_\_\_\_\_ DATE \_\_\_\_\_

### DESCRIPTION

This single heavy-duty valve performs all the functions required at the discharge side of centrifugal pumps.

The valve serves as a check valve as needed for zoned pumping, parallel and standby pumping application and for condenser-tower pumping needs. The disc and seat are hand lapped—insuring tight shut-off. The spring-loaded weighted disc prevents induced secondary circuit flow in Primary-Secondary applications.

A contoured disc permits pump discharge throttling; valve opening can be adjusted for good pump operating points allowing "single" operation of paralleled or standby pumps under a variety of requirements. The throttling feature also establishes an ability to meet specified pump operating conditions.

The special valve contour eliminates "rattle" under low flow conditions; a common check valve problem.

Turning the stem to the closed position provides tight shut-off. The valve stem indicating groove allows valve setting at the throttle or balance condition—permitting return to the "set" condition after shut-off. Turning the valve stem all the way up back-seats the valve and allows repacking under full line pressure.

The valve is quiet in operation from low flows to flows considerably in excess of normal designs.

### CONSTRUCTION

BODY: Cast iron. DISC AND SEAT: Bronze. STEM AND SPRING: Stainless steel. PACKING: Teflon-asbestos.

When ordering specify Model Number and Size.

### SCHEDULE

MAXIMUM WORKING PRESSURE 175 PSIG—MAXIMUM OPERATING TEMPERATURE 300°F.

MODEL NO.	FLANGE SIZE, INCHES	TAGGING INFORMATION	QUANTITY
3DS-2	2		2
3DS-2½	2½		
3DS-3	3		
3DS-4	4		
3DS-5	5		
3DS-6	6		
3DS-8	8		
3DS-10	10		

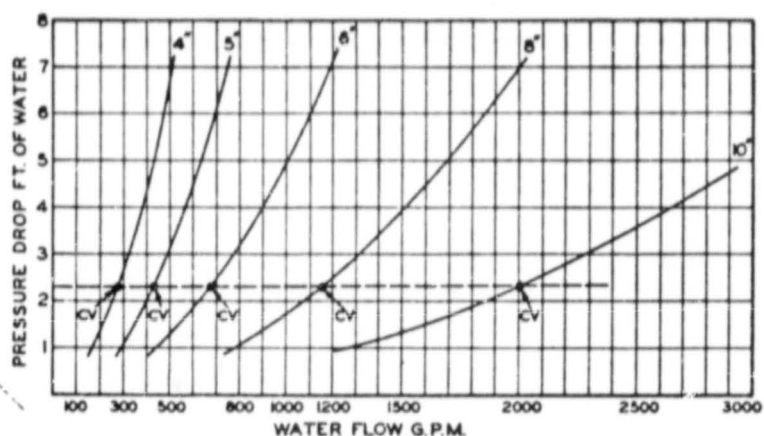
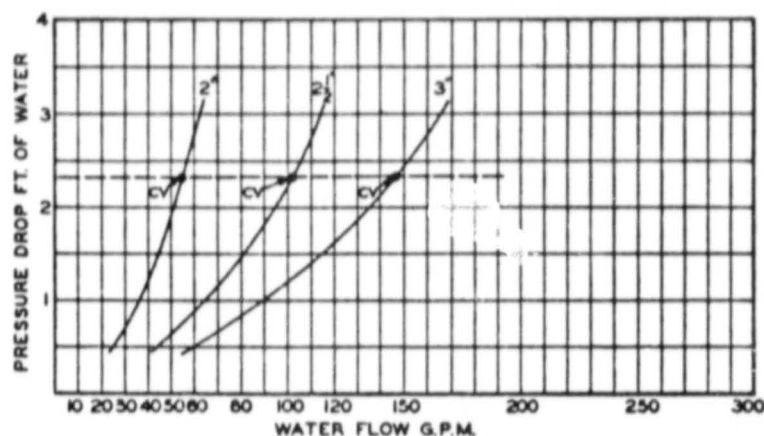
BELL & GOSSETT MORTON GROVE, ILL. 60053 **ITT**  
Fluid Handling Division, International Telephone and Telegraph Corporation

© COPYRIGHT 1970, 1974 BY INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

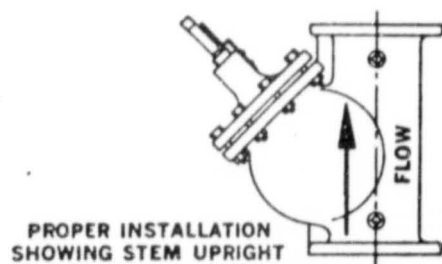
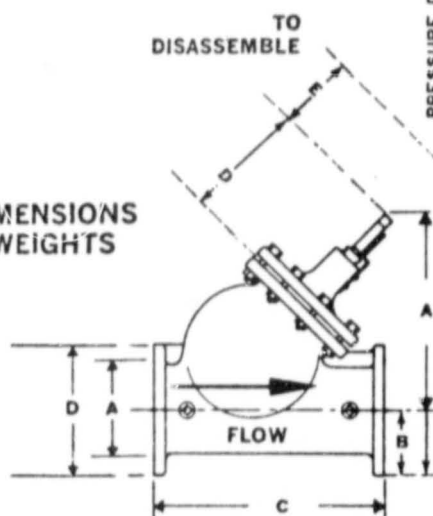


# STRAIGHT TRIPLE DUTY CHECK VALVE (Engineered Products)

## PERFORMANCE CHARACTERISTICS



## DIMENSIONS & WEIGHTS



PROPER INSTALLATION  
SHOWING STEM UPRIGHT

MODEL NO.	DIMENSIONS IN INCHES							APPROX. SHPG. WT. LBS.
	FLANGE SIZE	A		B	C	D	E	
OPEN		CLOSED						
3DS-2	2	8½	7¾	3	8⅝	6⅝	2¼	30
3DS-2½	2½	8⅝		3½	8⅝	7⅝		
3DS-3	3	9¼		8¾	3¾	10		8⅝
3DS-4	4	14⅝	12¾	4½	14½	10⅝	4¼	100
3DS-5	5	15½	13⅝	5	16	11¼	4⅝	124
3DS-6	6	16¾	15	5½	18		5½	185
3DS-8	8	19⅝	17¼	6¾	21½	11¾	7⅝	305
3DS-10	10	21¾	19¼	8	25½	12⅝	9¼	460

## TYPICAL SPECIFICATIONS

Check Valve—The contractor shall furnish and install as shown on plans a check valve with a spring-loaded weighted contoured disc and a calibrated adjustment feature permitting regulation of pump discharge flow and positive shut-off. Valves shall be designed to permit repacking under full line pressure. Unit shall be installed on discharge side of pump in a horizontal or vertical position with the stem up. Allow for minimum clearance of valve stem. This unit shall be cast iron body construction suitable for maximum working pressure of 175 PSIG and maximum operating temperature of 300° F. All units shall be ITT Bell & Gossett Model #3DS . . . or equal.

BELL & GOSSETT MORTON GROVE, ILL. 60053

Fluid Handling Division, International Telephone and Telegraph Corporation

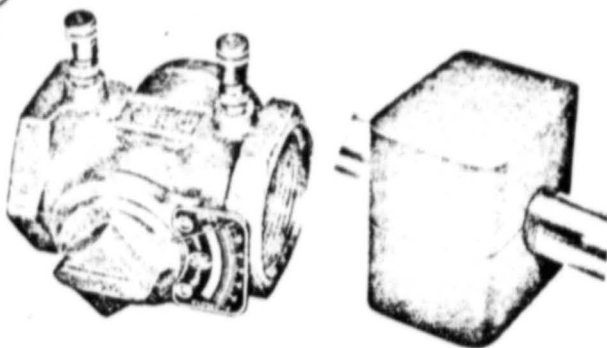
ITT

PRINTED IN U.S.A. 2-74

BELL & GOSSETT

**SUBMITTAL**

A-551  
REVISION 3



Engineered Products  
**Circuit Setter®**  
**Balance Valves**  
with NPT, Flanged and Solder Connections

NPT SHOWN

JOB <u>Arlington Racquetball Ct.</u>		B & G REPRESENTATIVE <u>Cummins-Wagner</u>	
ENGINEER _____		ORDER NO. _____	DATE _____
CONTRACTOR <u>Rust Construction</u>		SUBMITTED BY <u>Wally Bass</u>	DATE <u>12/14/78</u>
		APPROVED BY _____	DATE _____

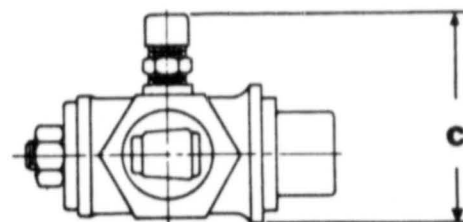
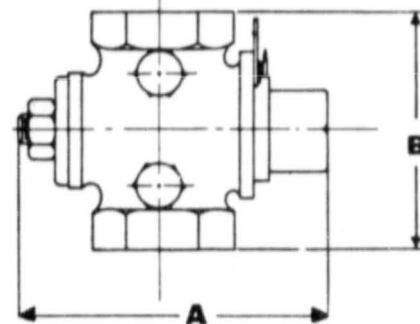
**OPERATING DATA**

MAXIMUM WORKING PRESSURE 125 PSIG.

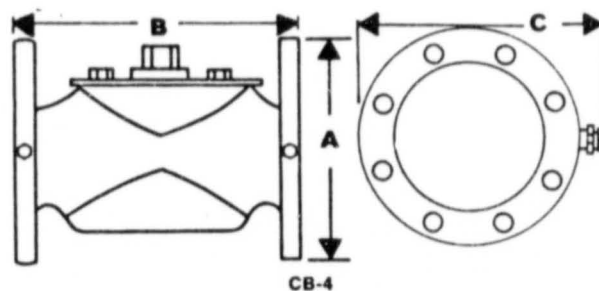
MAXIMUM OPERATING TEMPERATURE 250°F.

**DIMENSIONS AND WEIGHTS**

Model No.	DIMENSIONS IN INCHES								Weight in Lbs.
	Size		A		B		C		
			Normal	Insul	Normal	Insul	Normal	Insul	
CB-½	½	NPT	2¾	4¼	2⅝	4¼	2¼	4¼	¾
CB-¾	¾		2⅞		2¼		2⅜		1
CB-1	1		3½	5½	2⅝	3⅜	2⅝	4¾	1½
CB-1¼	1¼		3⅝		3		2⅞		2
CB-1½	1½		4⅜	6¼	3⅜	4¼	3⅝	6	3½
CB-2	2		5⅝		4⅞		3⅝		5½
CB-2½	2½		7⅞	9	5⅝	7	4½	7	16
CB-3	3		8		6⅝		5⅞		20
CB-4	4	FLG	9	9⅞	8	8	10⅞	10⅞	52



CB-1/2 THRU CB-3



CB-4

**SCHEDULE**

Model No.	Tagging Information	Quantity
CB- 1/2		
CB- 3/4		
CB-1		
CB-1 1/4		
CB-1 1/2		4
CB-2		1
CB-2 1/2		
CB-3		
CB-4		

**BELL & GOSSETT ITT**  
FLUID HANDLING DIVISION

# CIRCUIT SETTER® BALANCE VALVES (Engineered Products)

## DIMENSIONS AND WEIGHTS

Model No.	DIMENSIONS IN INCHES							Weight in Lbs.
	Size	A		B		C		
		Normal	Insul	Normal	Insul	Normal	Insul	
CB-½S	½			2¼	4¼	2¾	4¼	¾
CB-¾S	¾	1½	4¼	2¾		2½		1

## SCHEDULE

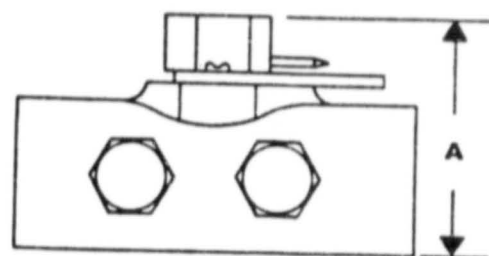
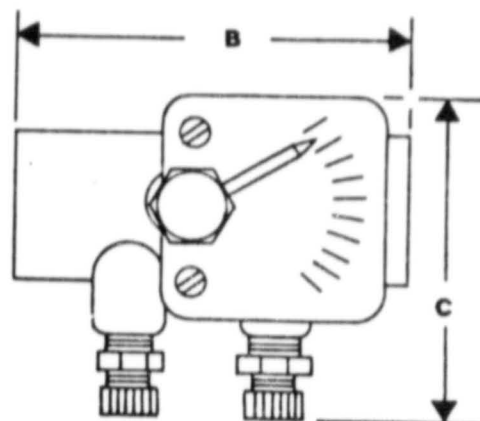
Model No.	Tagging Information	Quantity
CB-½S		
CB-¾S		

## TYPICAL SPECIFICATIONS

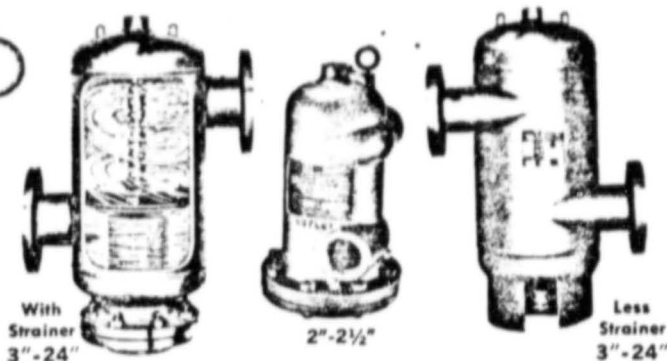
Furnish and install a calibrated (bronze/cast iron with bronze disc) balance valve equipped with readout valves. Each readout valve shall be fitted with an integral EPT check valve designed to protect the user from being wetted when setting up to monitor flow. An integral pointer shall register degree of valve opening. Each balance valve to be constructed with internal seals to prevent leakage around rotating element.

Each balance valve shall be constructed for 125 psig. working pressure at a maximum temperature of 250°F. and supplied with preformed polyurethane insulation suitable for use on heating and cooling systems. Each unit to be ITT Bell & Gossett No. CB-\_\_\_\_\_ Circuit Setter Balance Valve.

- NOTE 1 B&G Circuit Setter Balance Valves are designed in such a manner as to facilitate their use as service valves to restrict flow, but not as a drop tight shut-off valve.
- 2 B&G Circuit Setter Balance Valves are not recommended for use with meter connections pointing downward.



CB-½S and CB-¾S



# The ROLAIRTROL® Air Separator Air Control

NOTE: 3" MODELS HAVE NPT NOZZLES.

JOB Arlington Racquetball Ct.B & G REPRESENTATIVE Cummins-Wagner

UNIT TAG NO. \_\_\_\_\_

ORDER NO. \_\_\_\_\_

DATE \_\_\_\_\_

ENGINEER \_\_\_\_\_

SUBMITTED BY Wally BassDATE 12/14/CONTRACTOR Rust Construction

APPROVED BY \_\_\_\_\_

DATE \_\_\_\_\_

**DESCRIPTION**

The Rolairtrol Air Separator is designed with tangential openings to create a low velocity vortex where air is separated and removed from the circulating water. As with all other air separators Airtrol Tank Fittings must be included in the system to properly direct and confine air inside the compression tank.

**CONSTRUCTION**

Tank—2" and 2½"—Cast Iron, 3"-24"—Welded Steel; Air Collector Tube—Perforated Stainless Steel; Strainer—Removable Basket Type Galvanized Steel 3/16" diameter perforations (for free area see reverse side). Models R & RL-6 and larger have (8) ASME approved 3/16" Diameter telltale inspection holes on the shell.

Constructed in accordance with ASME and so stamped.

Patent No. 3,151,961

**SCHEDULE AND PERFORMANCE CHARACTERISTICS**

MODEL NO. AND CAPACITY				SIZE OF TANGENTIAL OPENINGS INCHES		TAGGING INFORMATION	QUANTITY
WITH STRAINER		LESS STRAINER					
MODEL NO.	GPM*	MODEL NO.	GPM*				
R-2	56	RL-2	56	2	NPT		1
R-2½	90	RL-2½	90	2½			
R-3	170	RL-3	170	3			
R-4	300	RL-4	300	4			
R-5	500	RL-5	530	5			
R-6	700	RL-6	850	6	FLANGED		
R-8	1300	RL-8	1900	8			
R-10	2000	RL-10	3200	10			
R-12	2750	RL-12	4800	12			
R-14	3400	RL-14	6100	14			
R-16	4400	RL-16	8000	16			
R-18	5200	RL-18	9700	18			
R-20	6300	RL-20	12000	20			
R-22	7400	RL-22	15000	22			
R-24	8500	RL-24	17000	24			

\*PRESSURE DROP: With strainer—14 elbow equivalents Less strainer—2½ elbow equivalents  
MAXIMUM DESIGN PRESSURE 125 P.S.I.G. MAXIMUM OPERATING TEMPERATURE 350°F

**TYPICAL SPECIFICATION**

Furnish and install as shown on plans an external air separation unit with integral system strainer consisting of a (cast iron/steel) tank ..... "x.....".

The unit shall have ..... (NPT/flanged) tangential inlet and outlet connections and internal perforated stainless steel air collector tube designed to direct released air into the compression tank. The unit shall also have a removable galvanized steel system strainer with 3/16" diameter perforations and a free area of not less than five times the cross sectional area of the connecting pipe (to be deleted if integral system strainer is not required). Installer shall remove and clean system strainer after 24-hours operation and after 30-days operation (to be deleted if integral system strainer is not required).

Unit must be constructed in accordance with A.S.M.E. boiler and pressure vessel code and stamped 125 PSIG design pressure.

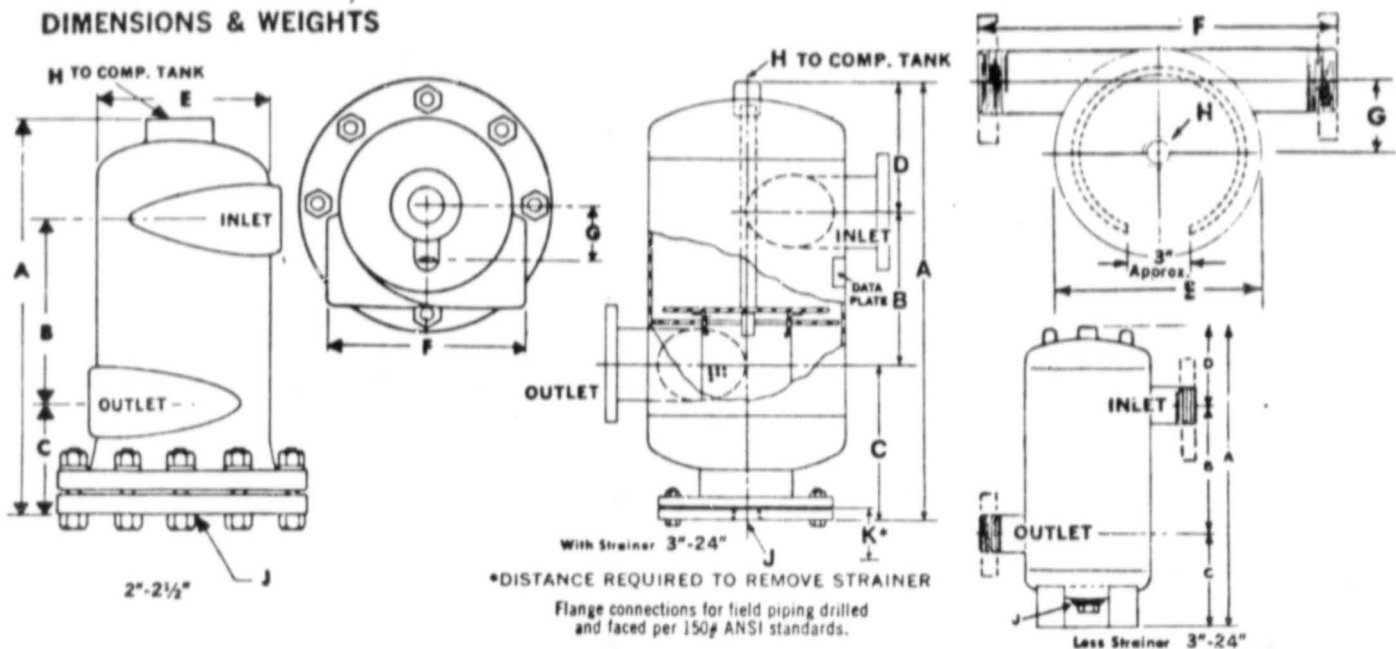
A blowdown connection shall be provided to facilitate routine cleaning of the unit.

Each air separator shall be ITT Bell & Gossett Model No. .... or equal.

**BELL & GOSSETT ITT**  
FLUID HANDLING DIVISION

# THE ROLAIRTROL Air Separator (Air Control)

## DIMENSIONS & WEIGHTS



NOTE: 3" MODELS HAVE NPT NOZZLES.

Model No.*	Capacity GPM		Size of Tangential openings	DIMENSIONS IN INCHES										STRAINER FREE AREA Sq. inches	Approx. Shpg. Wt. Lbs.
				A	B	C	D	E	F	G	H	J	K		
R-2	56	2	NPT	15 1/8	7	4	4 1/8	6 1/8	7 1/8	2	1	1	9	32	55
R-2 1/2	90	2 1/2		17 1/8	7 1/2	4 1/2	5 1/8	8 1/8	9 1/8	2 1/8				45	65
R-3	170	3		25 1 1/16	8	9 1/8	8 1/16	10 1/8	16 1/8	3 1 1/16				12	95
R-4	300	4	Flanged	30 1/8	10	11 1/4	9 1/2	12 1/4	20 1/2	4 1/8	1 1/2	2	17	14	165
R-5	500	5		36 1/8	12	13 1/16	10 1/16	16	23 1/4	5 1/8				19	220
R-6	700	6		42 1/8	14	15 1/2	13 1/8	18	25 1/4	5 1 1/16				21	300
R-8	1300	8		53 1 1/16	18	19 1/4	16 1/16	24	31 1/4	7 1 1/16				23	530
R-10	2000	10		64 1/8	22	22 1/16	20 1/16	30	37 1/4	9 1/8				28	860
R-12	2750	12		76 1 1/16	27	27 1/16	22 1/8	36	46 1/8	11 1/8				34	1200
R-14	3400	14		89 1/8	31 1/2	31 1/4	26 1/8	42	54 1/2	14				32	1820
R-16	4400	16		102 1/8	36	36 1/8	30 1/4	48	62 1/2	16				36	2610
R-18	5200	18		123	40 1/2	44 1/4	37 1/8	54	70 1/4	18				52	3500
R-20	6300	20		135 1/8	45	49 1/2	41 1/8	60	78	20				56	5405
R-22	7400	22		148 1/8	49 1/2	52 1/4	45 1/8	66	85 1/2	22				60	7420
R-24	8500	24		159 1/8	54	56 1/8	49 1/4	72	93 1/2	24				64	8850
RL-2	56	2	NPT	15 1/8	7	4	4 1/8	6 1/8	7 1/8	2	1	1	9	32	55
RL-2 1/2	90	2 1/2		17 1/8	7 1/2	4 1/2	5 1/8	8 1/8	9 1/8	2 1/8				45	65
RL-3	170	3		26 1/8	8	10 1/16	8 1/16	10 1/8	16 1/8	3 1 1/16				12	95
RL-4	300	4	Flanged	31 1/8	10	12 1/8	9 1/2	12 1/4	20 1/2	4 1/8	1 1/2	2	17	14	165
RL-5	530	5		36 1/16	12	13 1/16	10 1/16	16	23 1/4	5 1/8				19	220
RL-6	900	6		43 1/16	14	15 1 1/16	13 1/8	18	25 1/4	5 1 1/16				21	300
RL-8	1900	8		53 1 1/16	18	19 1/4	16 1/16	24	31 1/4	7 1 1/16				23	530
RL-10	3600	10		64 1 1/16	22	22 1/8	20 1/16	30	37 1/4	9 1/8				28	860
RL-12	4800	12		75 1/8	27	25 1/4	22 1/8	36	46 1/8	11 1/8				34	1200
RL-14	6100	14		95	31 1/2	35	28 1/2	42	54 1/2	14				32	1820
RL-16	8000	16		105 1/8	36	38 1/8	31 1/8	48	62 1/2	16				36	2610
RL-18	9700	18		123	40 1/2	44 1/4	37 1/8	54	70 1/4	18				52	3500
RL-20	12000	20		135 1/8	45	48 1/2	41 1/8	60	78	20				56	5405
RL-22	15000	22		148	49 1/2	52 1/4	45 1/8	66	85 1/2	22				60	7420
RL-24	17000	24		159 1/8	54	56 1/8	49 1/4	72	93 1/2	24				64	8850

\*Model "RL" Rolairtrol Air Separators are manufactured less strainer.



# Rigid Forms

DIAL SIZE	CATALOG NUMBERS				
	STEM LENGTH	90° BACK ANGLE FORM	STRAIGHT FORM	90° LEFT SIDE ANGLE FORM	90° RIGHT SIDE ANGLE FORM
3"	2½"	3A02	3S02	3L02	3R02
	4"	3A04	3S04	3L04	3R04
	6"	3A06	3S06	3L06	3R06
	9"	3A09	3S09	3L08	3R09
	12"	3A12	3S12	3L12	3R12
	15"	3A15	3S15	3L15	3R15
	18"	3A18	3S18	3L18	3R18
	24"	3A24	3S24	3L24	3R24

## STANDARD RANGES

-40 to 120°F in 2° divs.\*  
 25 to 125°F in 1° divs.\*  
 -70 to 150°F in 2° divs.\*  
 0 to 150°F in 2° divs.\*  
 0 to 200°F in 2° divs.\*  
 20 to 240°F in 2° divs.\*  
 50 to 300°F in 2° divs.\*  
 50 to 400°F in 5° divs.\*  
 50 to 500°F in 5° divs.\*  
 150 to 750°F in 10° divs.\*  
 200 to 1000°F in 10° divs.\*\*

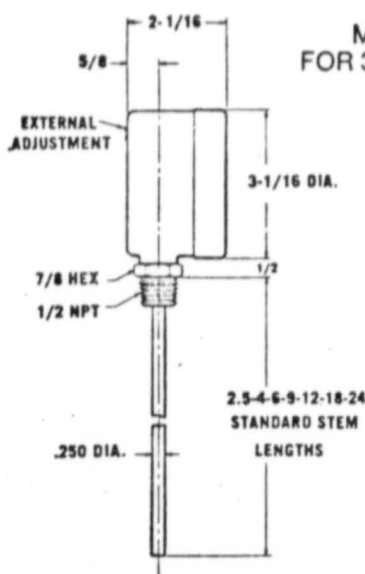
-50 to 50°C in 1° divs.\*  
 -70 to 70°C in 2° divs.\*  
 -10 to 110°C in 1° divs.\*  
 0 to 150°C in 2° divs.\*  
 0 to 200°C in 2° divs.\*  
 0 to 300°C in 5° divs.\*  
 100 to 400°C in 5° divs.\*  
 50 to 500°C in 5° divs.\*\*

## DUAL SCALES

Fahrenheit (on outside)	and	Centigrade (on inside)
25/125F*	and	-5/51C
-40/160F	and	-40/70C
0/200F	and	-18/92C
20/240F	and	-5/115C
0/250F	and	-18/123C
50/500F*	and	+10/260C
150/750F*	and	+65/400C
200/1,000F**	and	+95/540C

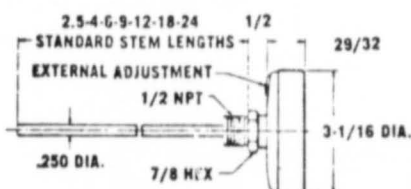
\*Not recommended with 2½" stem (on straight, left side or right side angle forms only).

\*\*Not recommended for continuous use above 800°F or equivalent C. For service above 800°F, use Weiskler filled-system dial thermometers or industrial liquid-in-glass thermometers.

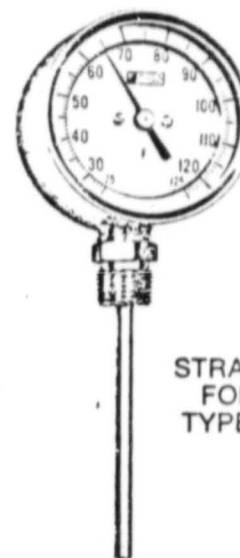


MOUNTING DIMENSIONS  
FOR 3" DIAL SIZE THERMOMETER  
TYPES 3S, 3L & 3R

MOUNTING DIMENSIONS  
FOR 3" DIAL SIZE  
THERMOMETER  
TYPE 3A



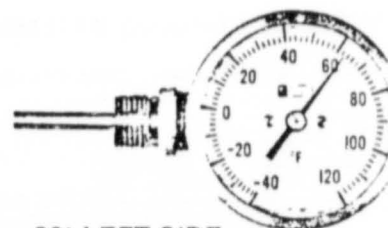
WHEN ORDERING: Give (1) Type No. (2) Range (3) Variations from standard, if any.



STRAIGHT  
FORM  
TYPE 3S



90° BACK  
ANGLE FORM  
TYPE 3A



90° LEFT SIDE  
ANGLE FORM  
TYPE 3L



## Max.-Min. & Wells

**MAXIMUM OR MINIMUM TYPE:** 3-inch dial back angle form thermometers can be equipped with a red index, for registering highest or lowest temperature. Index is "set" against either side of the indicating pointer by means of a knob at center of plastic crystal. With temperature change, the index is moved up (or down) scale where it remains until reset. Thus, one reading gives both the present and registered temperature. Add R1 to catalog number.

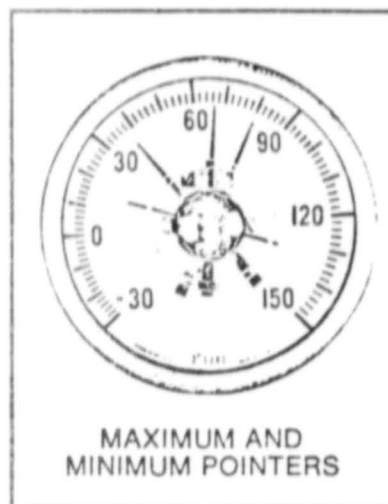
**MAXIMUM AND MINIMUM TYPE:** Similar to above except thermometer is equipped with two red indices for registering both the highest and the lowest temperatures reached, and a regular black pointer for indicating present temperature. Add R2 to catalog number.

**ACCURACY:** Indicated temperature, 1% of scale range; registered temperature, 1½ % of scale range.

### STANDARD RANGES

—40 to 120°F in 2° divs.*	—10 to 110°C in 1° divs.
25 to 125°F in 1° divs.**	0 to 150°C in 2° divs.
0 to 200°F in 2° divs.	
20 to 240°F in 2° divs.	
50 to 300°F in 2° divs.	

\*4" stem length minimum  
\*\*6" stem length minimum  
Other ranges, 2½" stem length minimum.



NOTE: Self-registering bi-metal thermometers are not recommended for applications where shock or excessive vibration will be encountered, where excessive fumes or moisture are present, or where head temperature will exceed 150°F (65°C).

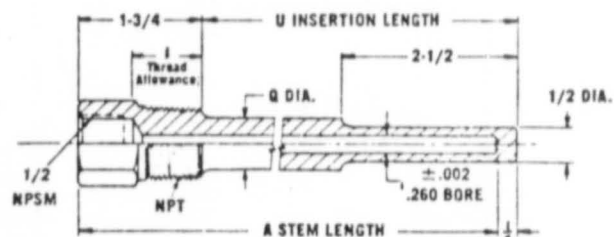
## WELLS AND FLANGE FOR INDUSTRIAL BI-METAL THERMOMETERS

### WELLS WITHOUT LAGGING EXTENSION

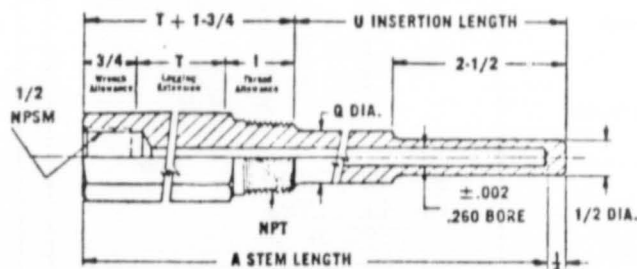
¾" NPT				1" NPT			
CATALOG NO.	A	U	Q	CATALOG NO.	A	U	Q
S3-4	4	2½	—	S4-4	4	2½	—
S3-6	6	4½	¾	S4-6	6	4½	¾
S3-9	9	7½	¾	S4-9	9	7½	¾
S3-2	12	10½	¾	S4-2	12	10½	¾
S3-5	15	13½	¾	S4-5	15	13½	¾
S3-8	18	16½	¾	S4-8	18	16½	¾
S3-X	24	22½	¾	S4-X	24	22½	¾

### WELLS WITH LAGGING EXTENSION

¾" NPT					1" NPT				
CATALOG NO.	A	U	T	Q	CATALOG NO.	A	U	T	Q
L3-6	6	2½	2	—	L4-6	6	2½	2	—
L3-9	9	4½	3	¾	L4-9	9	4½	3	¾
L3-2	12	7½	3	¾	L4-2	12	7½	3	¾
L3-5	15	10½	3	¾	L4-5	15	10½	3	¾
L3-8	18	13½	3	¾	L4-8	18	13½	3	¾
L3-X	24	19½	3	¾	L4-X	24	19½	3	¾



WITHOUT LAGGING EXTENSION



WITH LAGGING EXTENSION

Catalog numbers require insertion of third digit to denote well material.

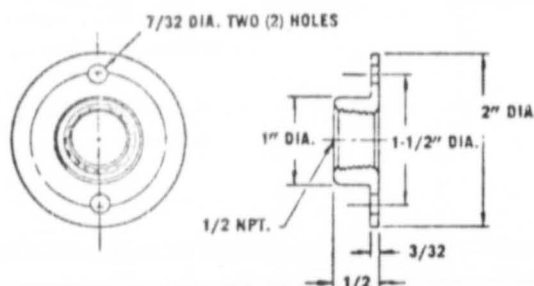
B=Brass\* G=Type 304 Stainless Steel  
S=Carbon Steel

J=Type 316 Stainless Steel M=Monel

\*Brass wells are not recommended for installations involving high pressures and/or temperatures over 400°F.

### ½" NPT FLANGE

Satin finish chrome plated brass. For use in air ducts, dryers, ovens, etc. Cat. No. 2F2



## TYPE EA14 GAUGE

Produced especially for the large volume user, this rugged Weksler gauge is subjected to rigorous quality control standards. Long life and repeatable accuracy is assured.

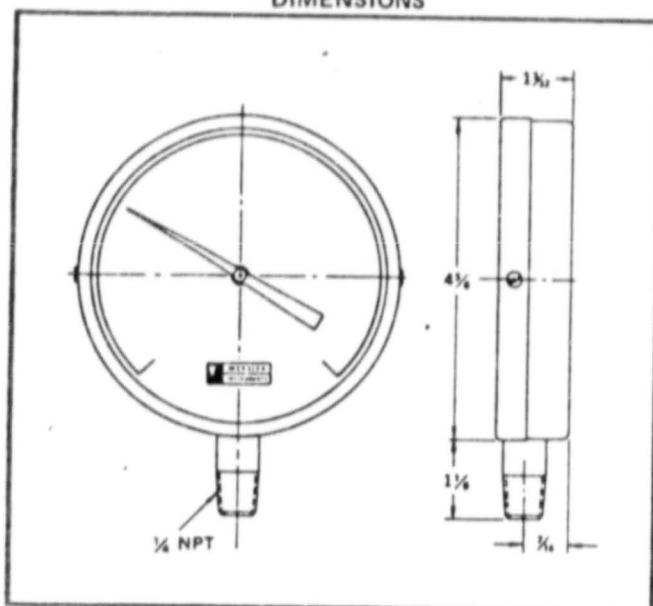
- 4½" Dial size
- Corrosion resistant stainless steel case and ring. Plastic lens
- Balanced adjustable black pointer
- Guaranteed accurate to 1% of range

### SPECIFICATIONS

- Silver soldered phosphor bronze tube with brass socket. Suitable for steam, water, air, oil, gas, or any medium not corrosive to copper alloys.
- Durable phosphor bronze movement provides good wearing characteristics and is recommended for average general use.
- Easy to read dial; white background with bold black numerals and graduations, 270° arc.
- ¼" N.P.T. bottom connection.



### DIMENSIONS



### PRESSURE RANGES

DIAL RANGES	FIGURE INTERVALS	SMALLEST GRADUATION
0-30 p.s.i.	5 p.s.i.	½ p.s.i.
0-60 p.s.i.	10 p.s.i.	1 p.s.i.
0-100 p.s.i.	10 p.s.i.	1 p.s.i.
0-160 p.s.i.	20 p.s.i.	2 p.s.i.
0-200 p.s.i.	20 p.s.i.	2 p.s.i.
0-300 p.s.i.	50 p.s.i.	5 p.s.i.
0-500 p.s.i.	50 p.s.i.	5 p.s.i.

### VACUUM RANGES

DIAL RANGES	FIGURE INTERVALS	SMALLEST GRADUATION
0-30" Hg. Vac.	5 in.	½ in.

### COMPOUND RANGES

DIAL RANGES	FIGURE INTERVALS	SMALLEST GRADUATION
30"-0-30 p.s.i.	10" & 5 p.s.i.	1" & 1 p.s.i.
30"-0-100 p.s.i.	15" & 10 p.s.i.	5" & 1 p.s.i.
30"-0-150 p.s.i.	30" & 25 p.s.i.	5" & 5 p.s.i.
30"-0-300 p.s.i.	30" & 50 p.s.i.	5" & 5 p.s.i.

NOTE: On compound range gauges the zero graduation is not to be used as a calibration reference point.

WHEN ORDERING: Specify (1) Type EA14 (2) Range.

## TYPE UA12-0 BEE LINE GAUGE

### AVAILABLE RANGES

0-30" Hg. Vac.	0-30 p.s.i.
	0-60 p.s.i.
30"-0-30 PSI	0-100 p.s.i.
30"-0-60 PSI	0-160 p.s.i.
30"-0-150 PSI	0-200 p.s.i.
30"-0-300 PSI	0-300 p.s.i.
	0-600 p.s.i.

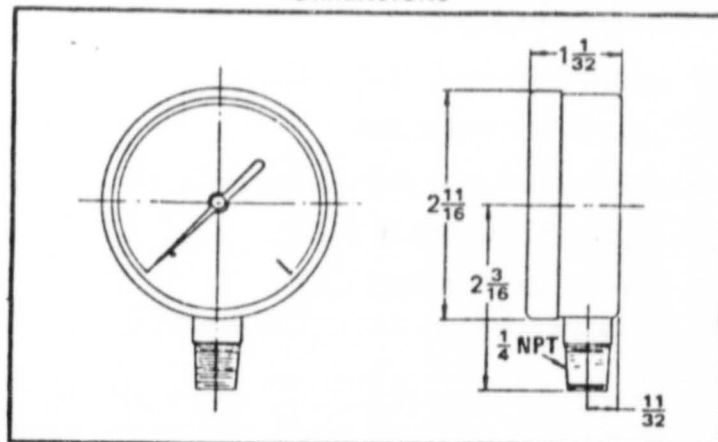


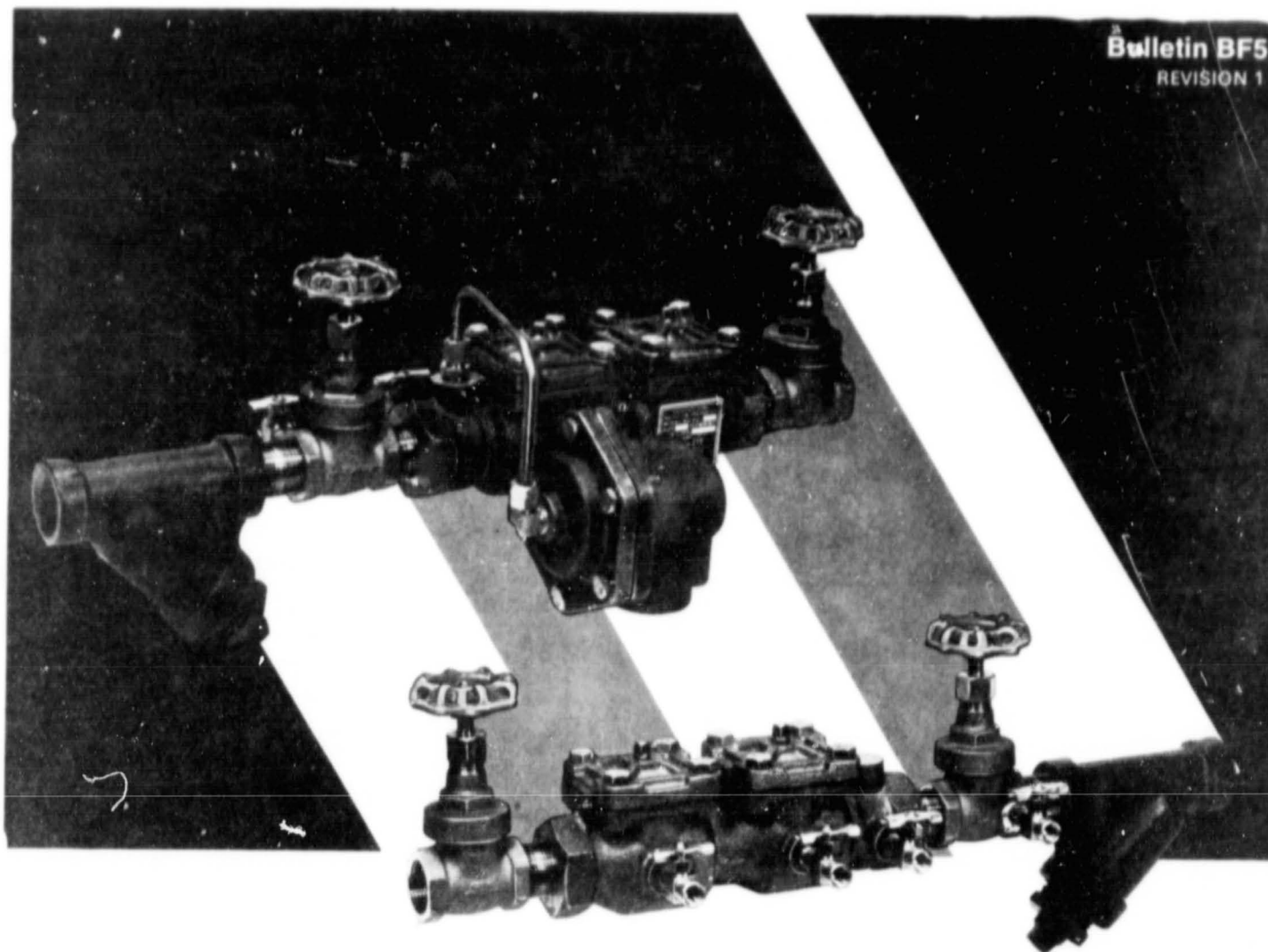
An inexpensive, rugged utility pressure gauge for the broad commercial and industrial market. 3-2-3% accuracy.

Furnished in ¼" NPT, bottom connected steel cases, the 2½" dial size Bee Line gauges measure water, air, oil, gas or any other medium not corrosive to brass and phosphor bronze.

WHEN ORDERING: Specify (1) Type UA12-0; (2) Range.

### DIMENSIONS





## Features:

- Bronze Body Construction
- Low Pressure Loss
- Horizontal or Vertical Installation
- Easily Serviced in Line
- Complete Product Line

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**LAWLER ITT**  
FLUID HANDLING DIVISION

### Where are they used?

Double check backflow preventers are used on direct water connections where the possibility of non-toxic contamination from backflow or back siphonage exists, but does not constitute an actual health hazard.

Lawler double check backflow preventers represent trouble free, and if need be, easily accessible valves for inspection and servicing. The internal design of the flow channel is smooth to maximize flow and with no obstructions or cavities to cause turbulence.

There are very few moving parts and the tolerances of the design are such that chatter and vibration are eliminated.

Be sure to follow local codes when specifying double check backflow preventers.

### How do they operate?

#### 1. Static Pressure

Both check valves are held tightly closed by the spring loading on the check valve disc.

#### 2. Normal Flow

Both check valves open as the equipment down stream requires water. Lawler double check valves minimize pressure loss.

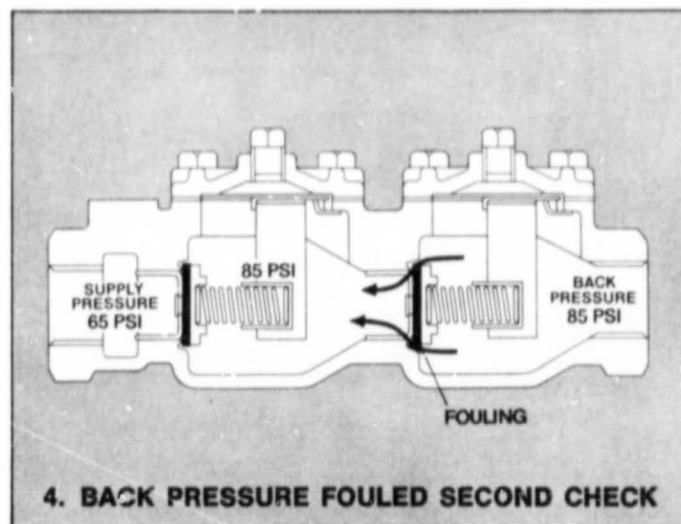
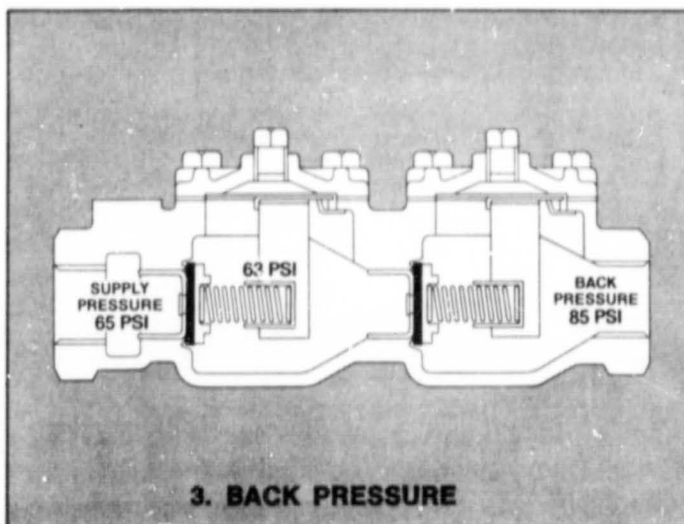
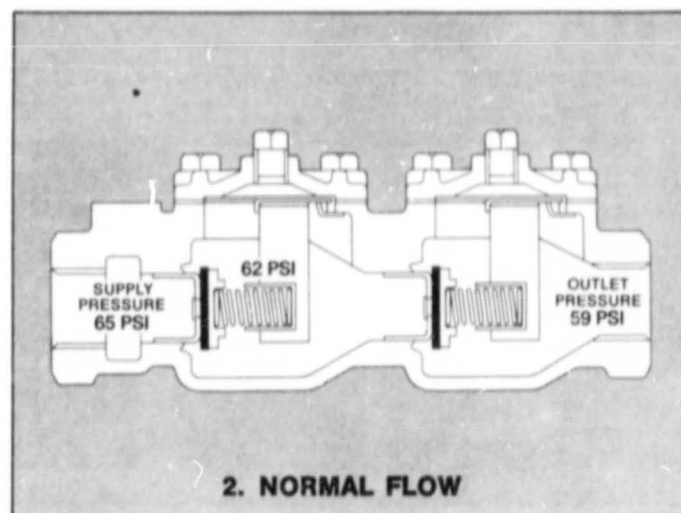
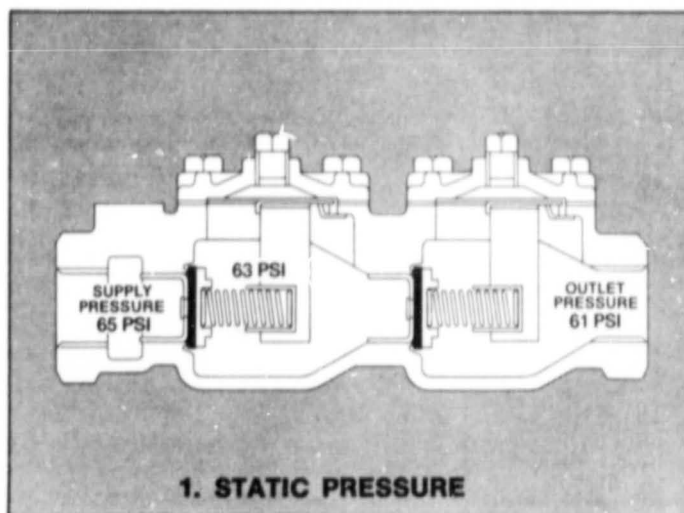
#### 3. Back Pressure

The spring loaded check valves close immediately on back pressure protecting the potable system.

#### 4. Back Pressure with Fouled Check

The spring loaded double check valve will continue to protect the potable system if either check valve is fouled.

Double check backflow preventers should not be used where a health hazard exists.





## Where are they used?

Reduced zone backflow preventers are used on direct water connections and provide complete and dependable protection against contamination from backflow or back siphonage, even where potential health hazards exist.

As with Lawler double check assemblies, Lawler reduced zone backflow preventers represent trouble free, and if need be, easily accessible valves for inspection and servicing. Similarly, the internal design of the flow channel is smooth to maximize flow and with no obstructions or cavities to cause turbulence.

There are very few moving parts and the tolerances of the design are such that chatter and vibration are eliminated.

Be sure to follow local codes when specifying reduced zone backflow preventers.

## How do they operate?

### 1. Static Pressure

Both check valves are held tightly closed by spring loading on the check valve discs. The relief valve is held tightly closed by the inlet pressure on the front of the diaphragm.

### 2. Normal Flow

Both check valves open as the equipment down stream requires water. The relief valve is held tightly closed by the inlet pressure on the front of the diaphragm.

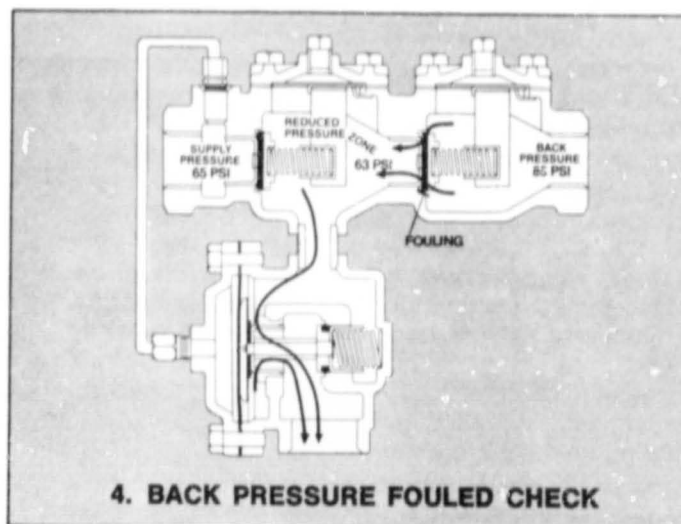
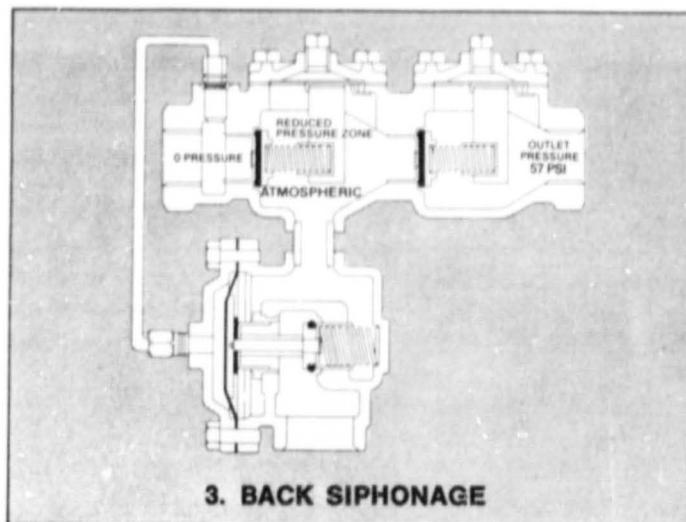
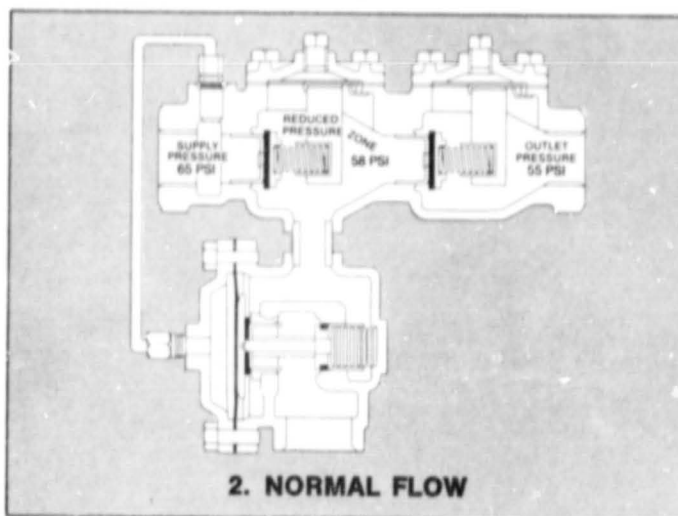
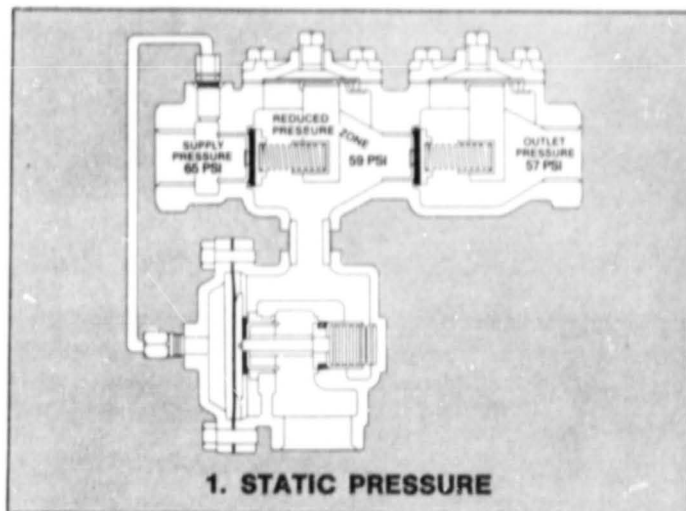
### 3. Back Siphonage

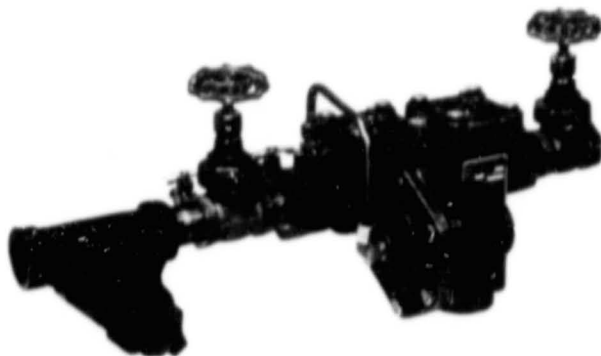
During periods of negative inlet pressure, both check valves are held tightly closed.

The relief valve is fully open because there is no pressure on the front of the diaphragm. All water in the reduced zone area is vented to atmosphere.

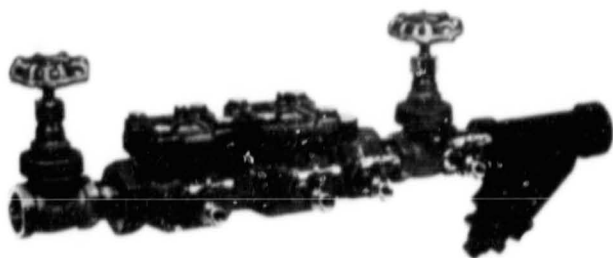
### 4. Back Pressure with Fouled Check

As the water pressure in the reduced zone area approaches 2 psi of the inlet pressure, the primary relief valve opens discharging the water from the zone. This visual signal will continue until the problem has been corrected.





**REDUCED ZONE BACKFLOW PREVENTER**



**DOUBLE CHECK BACKFLOW PREVENTER**

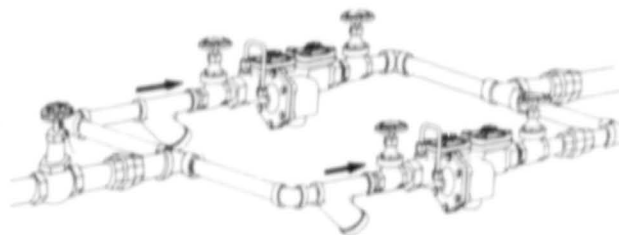
Local codes will usually determine whether the RZ (reduced zone) or DC (double check) models should be used.

In each case the backflow preventer is utilized to prevent contaminated substances from flowing back into the potable water supply.

Double check backflow preventers are specified for use on direct connections where backflow would be considered a nuisance and does not constitute a health hazard. Typical applications include: pressure steam kettles, food processing operations, sprinkler systems and water make-up lines on hot water or steam boilers where toxic substances are not used.

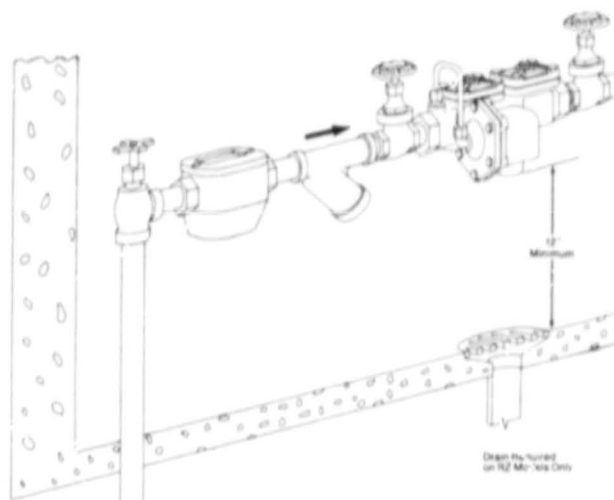
Reduced zone backflow preventers are specified for use on direct connections where back pressure or back siphonage would be considered a potentially serious health hazard. If, for any reason, either check valve should malfunction during periods of back pressure or back siphonage, the relief valve would open discharging the contaminated water to atmosphere. If the diaphragm should fail, the backflow preventer would continue to function properly venting any contaminate to atmosphere.

Typical applications include: hospitals, laboratories, industrial processes, boilers and irrigation systems.

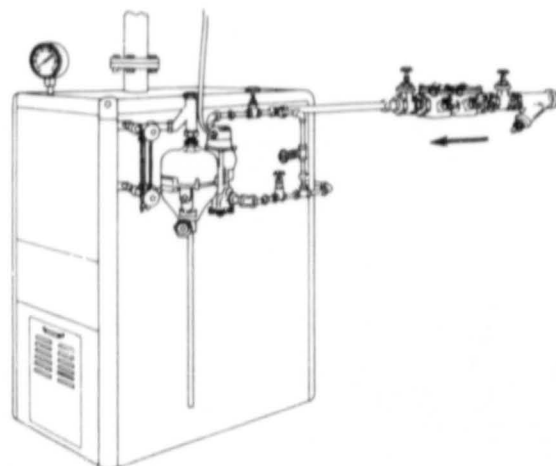


#### **PARALLEL INSTALLATION**

Where continuous flow may be required even during times of servicing or testing, or where greater capacity than a single unit may be necessary, then two units connected in parallel are recommended.

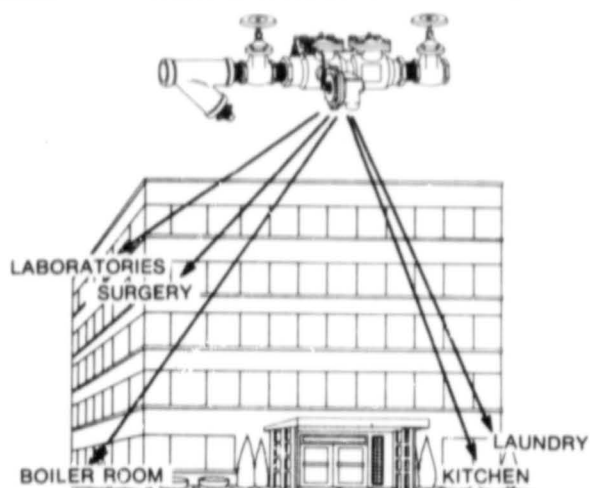


**INCOMING WATER SUPPLY**

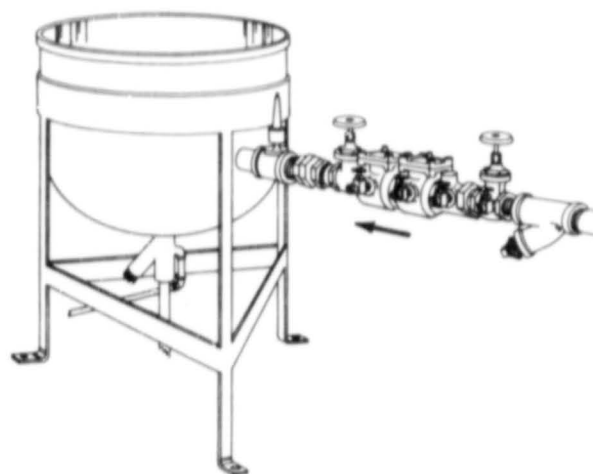


**LOW AND HIGH PRESSURE BOILERS**

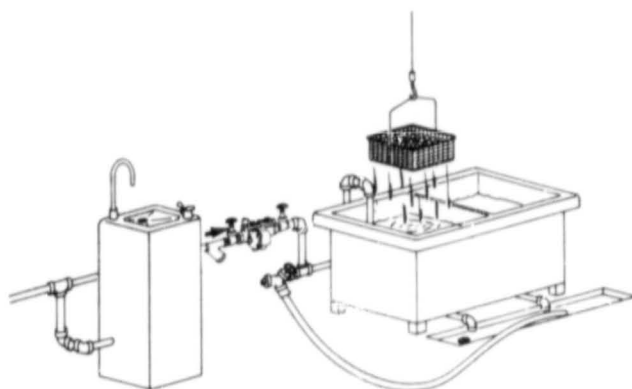




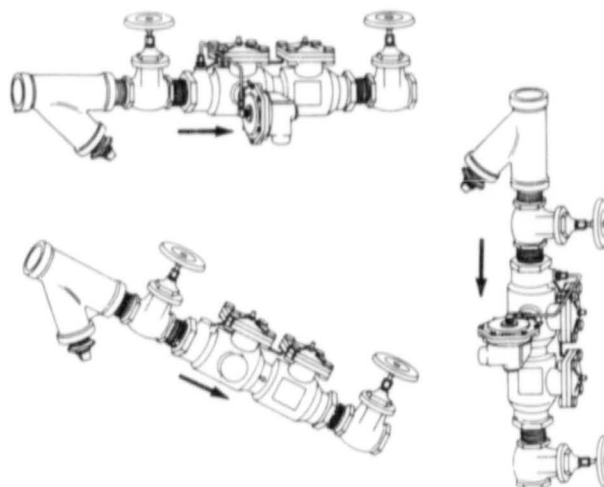
**HOSPITALS AND INSTITUTIONS**



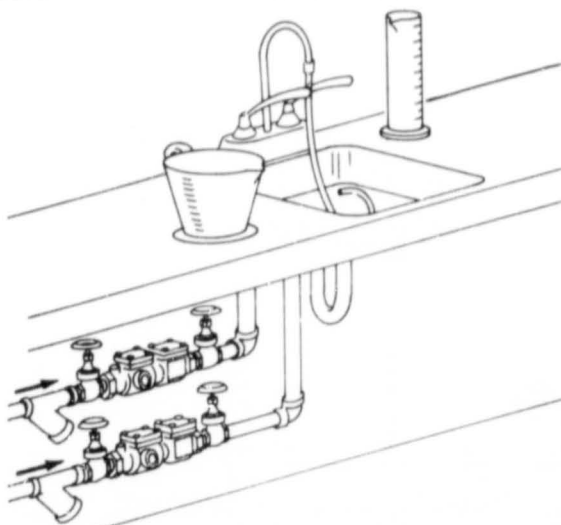
**FOOD PROCESSING —  
PRESSURE STEAM KETTLES**



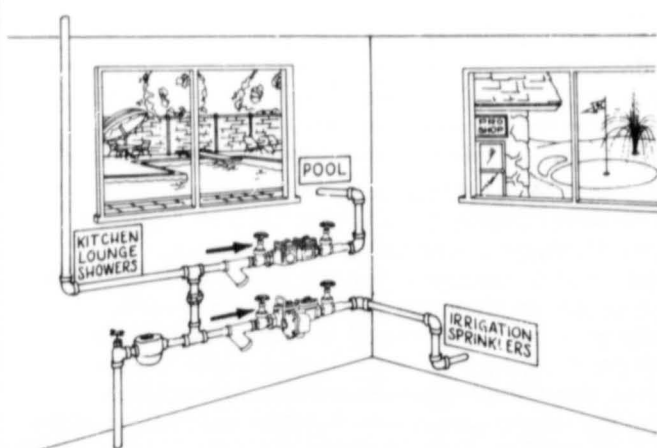
**INDUSTRIAL PLANTS — PLATING,  
PICKLING AND CAUSTIC TANKS**



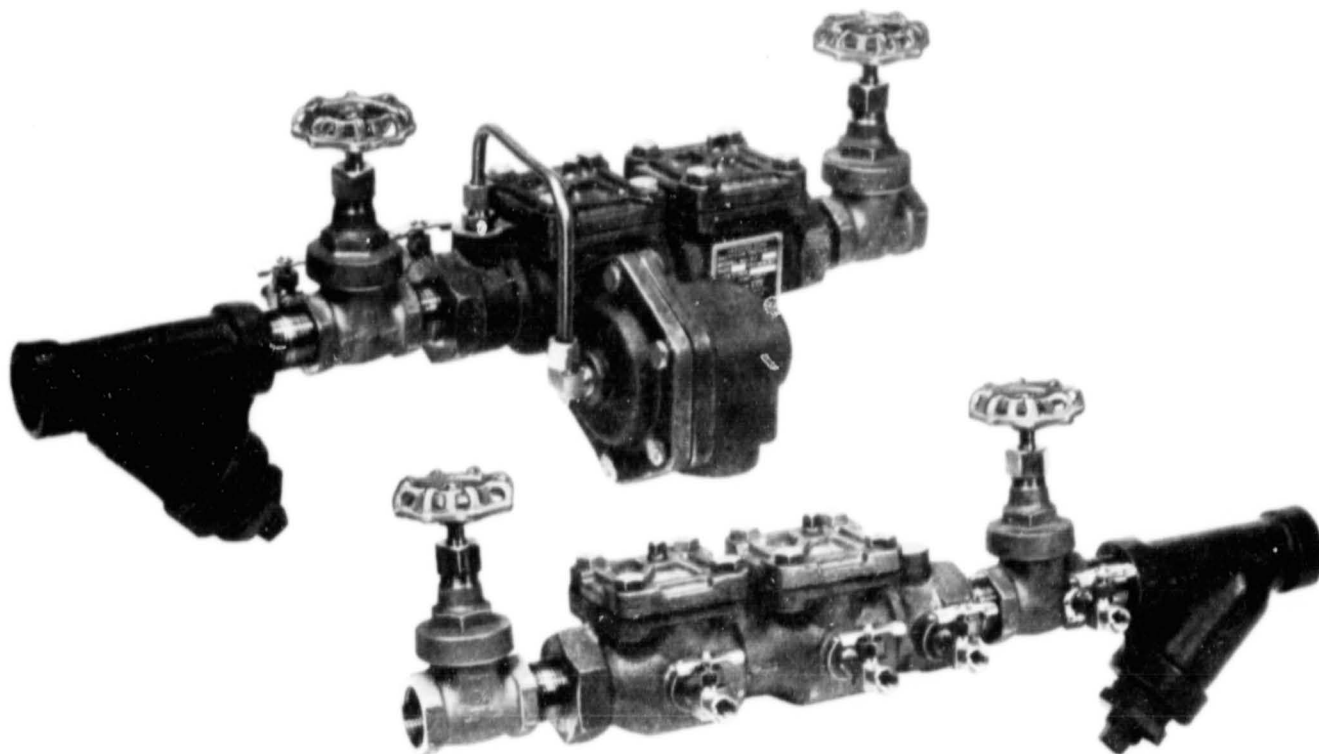
**HORIZONTAL OR VERTICAL INSTALLATION**



**LABORATORY — INDUSTRIAL, MEDICAL, SCHOOL**



**SPRINKLING AND IRRIGATION SYSTEMS**



- **Bronze Body Construction**

Lawler backflow preventers feature bronze body construction fitted with stainless steel bolts and internal parts.

- **Low Pressure Loss**

Lawler reduced zone and double check backflow preventers have smooth flow channels to maximize flow. Since there are no unnecessary obstructions or cavities in the flow area, turbulence is eliminated.

- **Horizontal and Vertical Installation**

Lawler backflow preventers may be installed in horizontal or vertical position or any angle in

between as long as the direction of flow is downward.

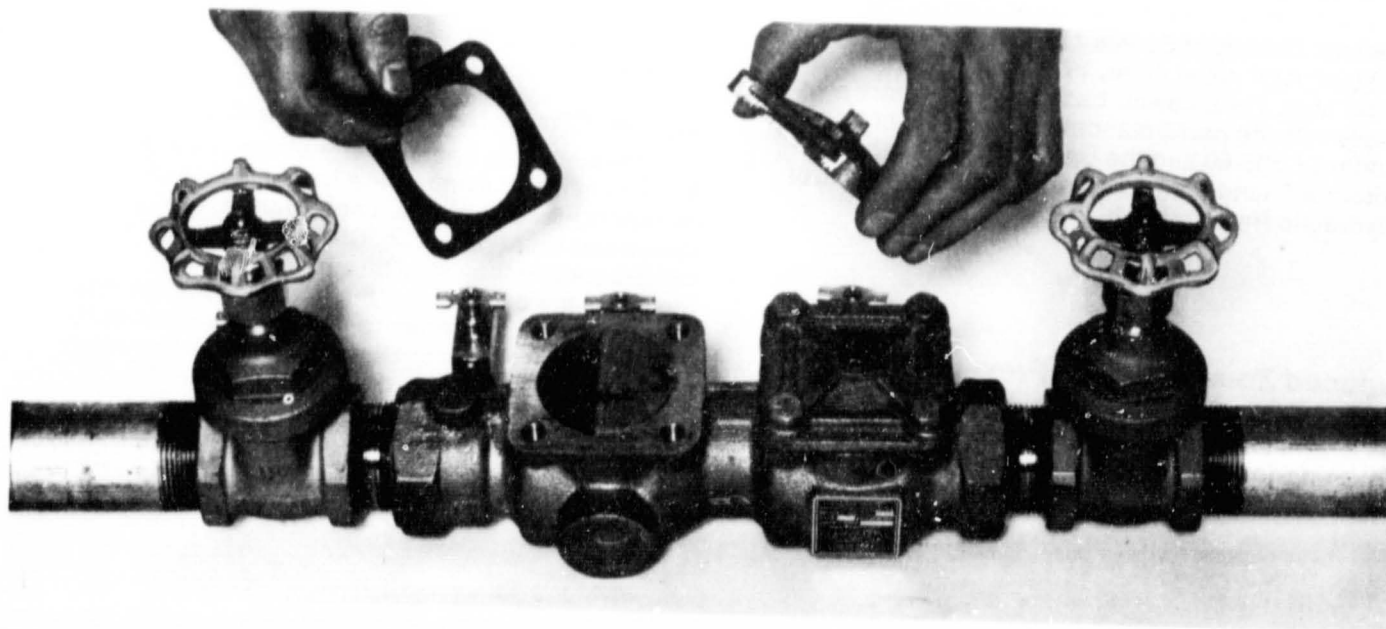
- **Easily Serviced In Line**

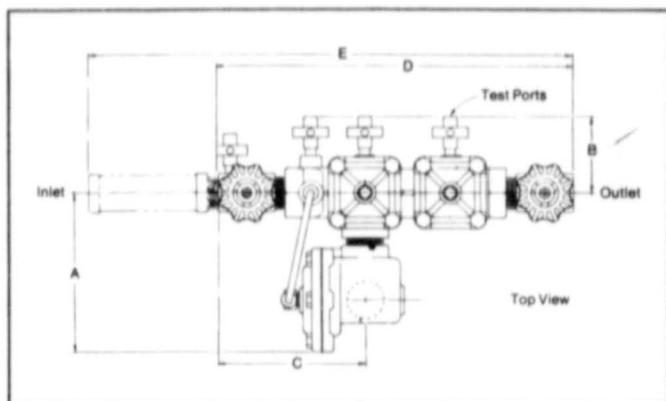
If servicing should be necessary, all internal working parts are easily accessible simply by removing the covers. It is not necessary to remove the backflow preventer from the line.

- **Complete Product Line**

Lawler offers a complete product line of reduced zone and double check backflow preventers in sizes  $\frac{3}{4}$ ", 1",  $1\frac{1}{4}$ ",  $1\frac{1}{2}$ " and 2".

All models are available with or without strainer.





### Reduced Zone Models

Model Number	Pipe Size (NPT)	A	B	C	D	E*
RZ-3 & RZ-3-S*	3/4	5 9/16	2 1/16	5 1/4	12 15/16	17 7/16
RZ-4 & RZ-4-S*	1	5 9/16	2 1/16	5 3/8	13 3/8	18 5/8
RZ-5 & RZ-5-S*	1 1/4	6	3 9/16	6 7/16	16 3/8	22 3/8
RZ-6 & RZ-6-S*	1 1/2	6	3 9/16	6 3/4	17 3/16	24 3/16
RZ-8 & RZ-8-S*	2	7 1/16	3 7/8	7 7/8	20 1/16	28 1/2

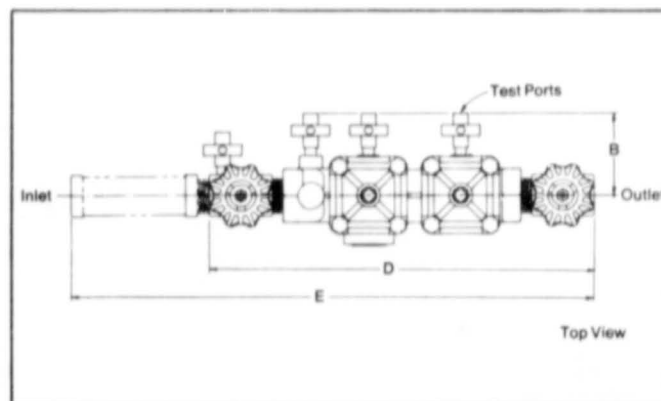
\*Models with Strainer

Lawler backflow preventers feature an all bronze body construction fitted with stainless steel bolts and internal parts. The valve discs are faced with a molded elastomer for a tight positive seal.

Lawler backflow preventers have been tested by the Twining Laboratories, Inc. and certified by the American Society of Sanitary Engineering Standard 1013 (reduced zone) June, 1971, and 1015 (double check) May, 1972. Lawler backflow preventers also comply with the performance requirements of AWWA Standard C506-69 and the University of Southern California Foundation for Cross Connection Control & Hydraulic Research.

### Reduced Zone Backflow Preventer

The reduced zone backflow preventer in sizes 3/4" thru 2" shall be a complete assembly consisting of two spring-loaded poppet check valves, one



### Double Check Models

Model Number	Pipe Size (NPT)	B	D	E*
DC-3 & DC-3-S*	3/4	2 1/16	12 15/16	17 7/16
DC-4 & DC-4-S*	1	2 1/16	13 3/8	18 5/8
DC-5 & DC-5-S*	1 1/4	3 9/16	16 3/8	22 3/8
DC-6 & DC-6-S*	1 1/2	3 9/16	17 3/16	24 3/16
DC-8 & DC-8-S*	2	3 7/8	20 1/16	28 1/2

\*Models with Strainer

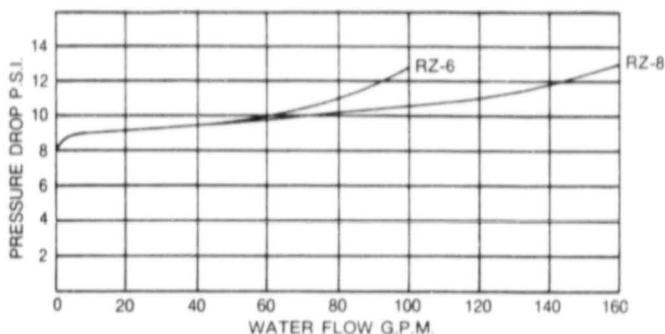
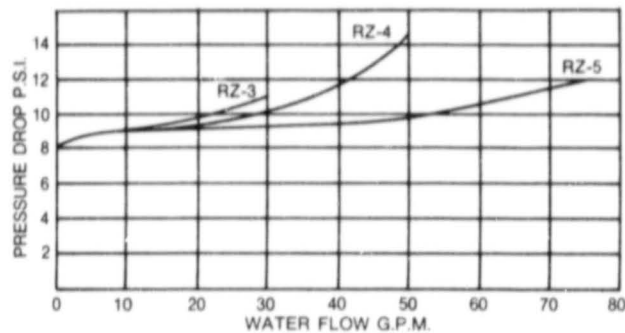
diaphragm operated differential relief valve located between the check valves, two gate valves and four test cocks. If, for any reason, the pressure differential between the upstream and downstream check valves of the unit drops to within 2 psi of the inlet pressure, the differential relief valve shall open and maintain the proper pressure differential.

Check valves and differential relief valves shall be constructed so as to be serviced without removing the device from the line. These devices must be rated at 150 psi working pressure and water temperature to 210°F and conform to specifications of ASSE 1013. The reduced zone backflow preventer shall be similar in all respects to the Lawler ITT Series RZ Backflow Preventer.

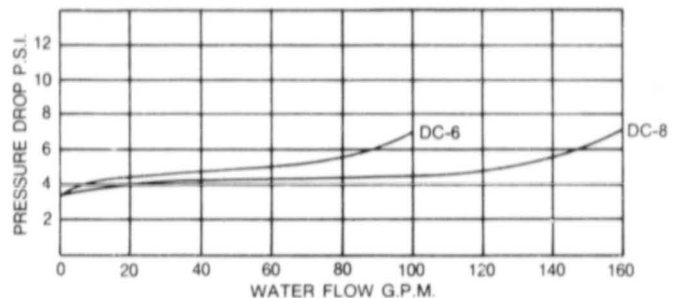
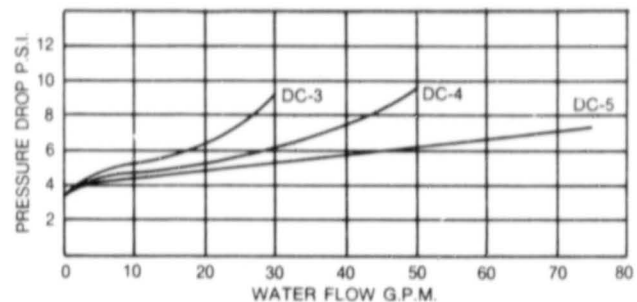
### Double Check Backflow Preventer

The double check backflow preventer in sizes 3/4" thru 2" shall be a complete assembly and consist of two spring-loaded poppet check valves, two gate valves and four test cocks. Check valves shall be constructed so they may be serviced without removing the device from the line and shall be rated at 150 psi working pressure and water temperature to 210°F. The assembly shall conform to the specifications of ASSE 1015. The double check backflow preventer shall be similar in all respects to the Lawler ITT DC Backflow Preventer.

## Reduced Zone (RZ)



## Double Check (DC)



## Pressure drop through valves and strainers

(Capacity Curves do not include gate valves or strainers)

Note:  $\left(\frac{Q}{C_v}\right)^2 = \Delta P$

Q = Flow

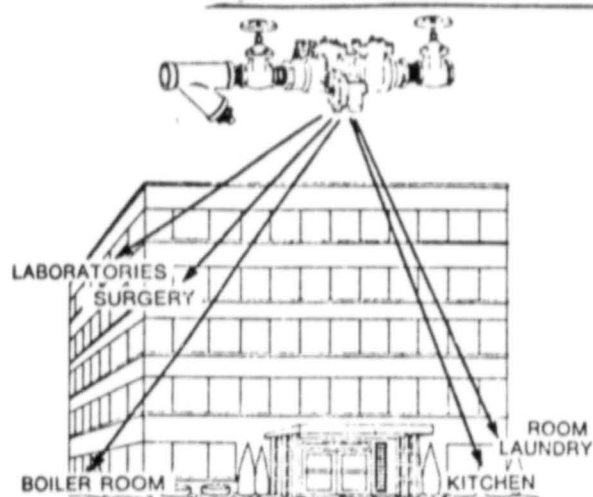
$\Delta P$  = Pressure Drop psi

1. For additional pressure drop at a given flow determine the  $\Delta P$  using the above formula and  $C_v$  values from the table.
2. Add the calculated  $\Delta P$  to the pressure drop as shown on the model curves to arrive at the total pressure drop.

Pipe Size (NPT)	$C_v$ Valves* & Nipples	$C_v$ Strainers**
3/4"	19.49	13.7
1"	52.70	19.1
1 1/4"	72.13	30.0
1 1/2"	111.11	54.0
2"	216.93	62.0

\* Valves wide open

\*\* Strainers new and clean



**Hospitals, Institutions**

Figure 2

Local codes will usually dictate whether the RZ (Reduced Zone) or the DC (Double Check) models should be used. In each case the Backflow Preventer is utilized to prevent contamination from flowing back to the potable water supply.

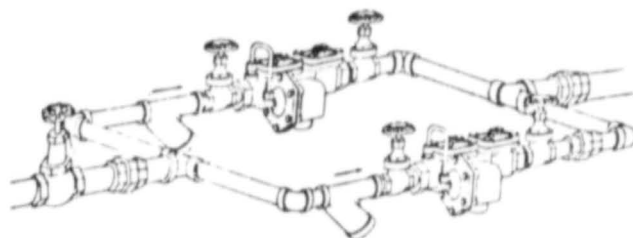


Figure 3

## PARALLEL INSTALLATION

Where continuous flow may be required even during times of servicing or testing, or where greater capacity than a single unit may be necessary, then two units connected in parallel would be recommended.

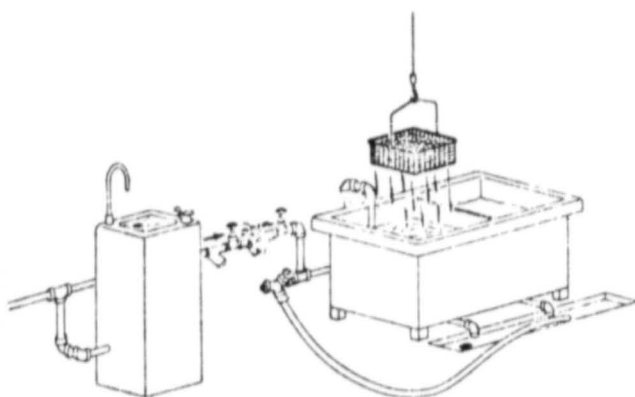


Figure 4

**Industrial Plants—Plating, Pickling and Caustic Tanks**

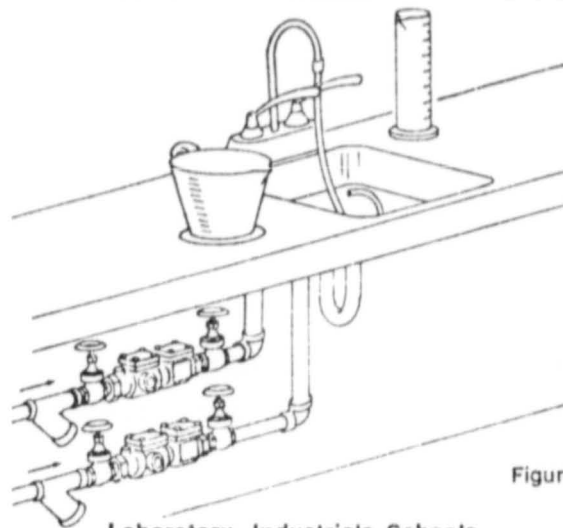


Figure 5

**Laboratory—Industrials, Schools**

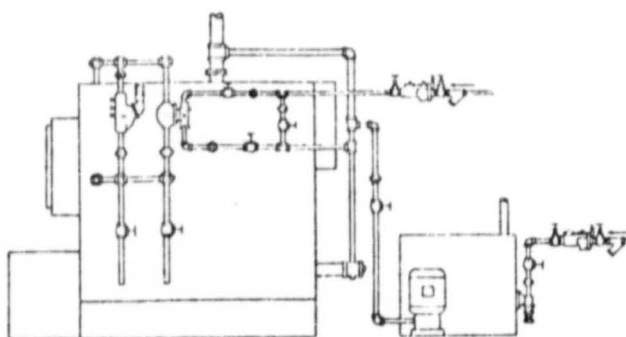


Figure 6

**Boiler Room—Low and High Pressure Boilers**

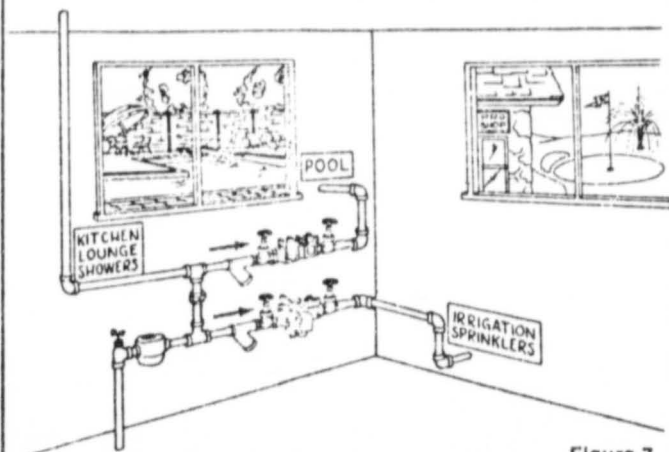


Figure 7

**Sprinkling and Irrigation Systems**

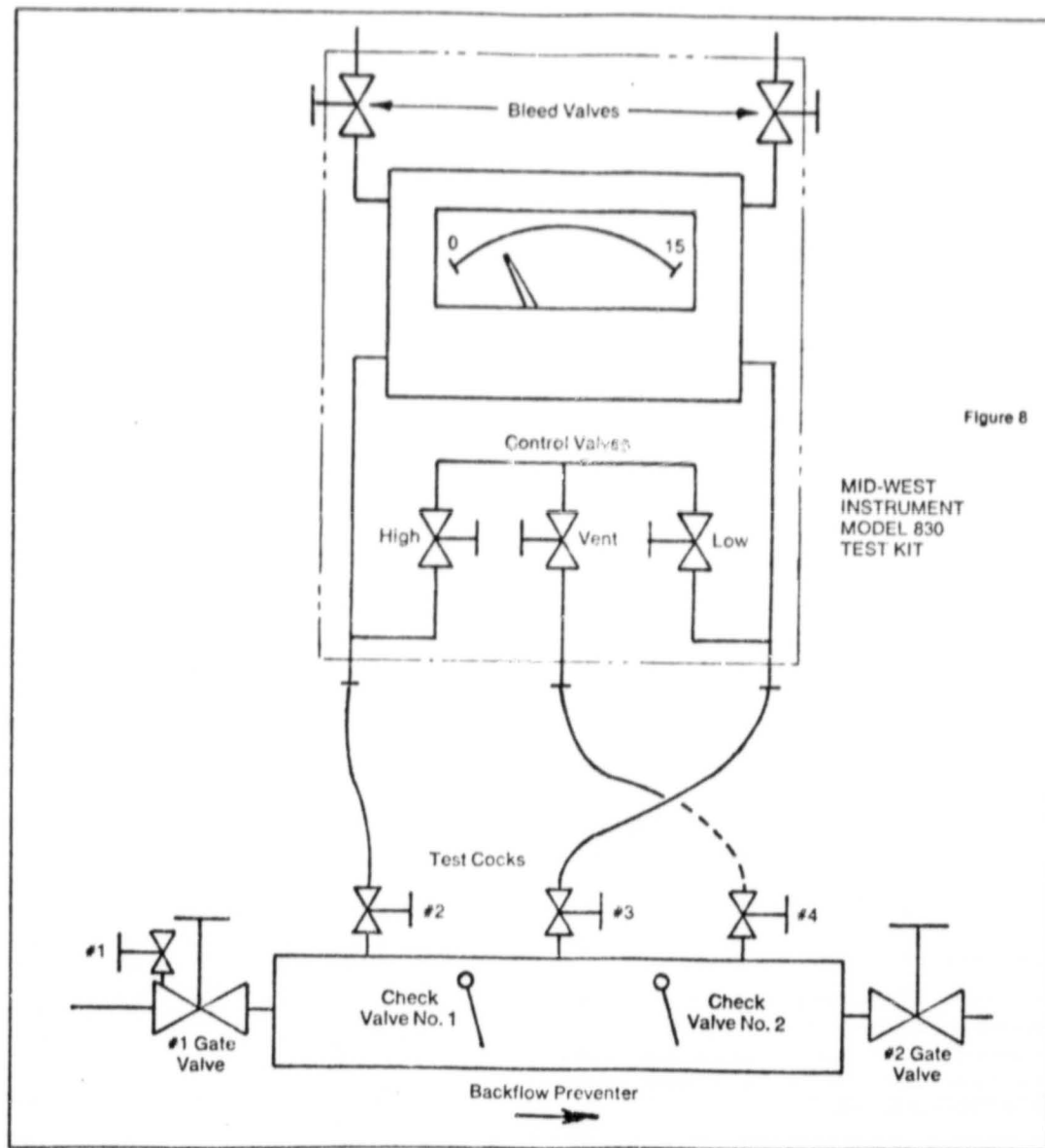


Backflow Preventer devices offer a high degree of safety in the prevention of contamination of potable water. A backflow preventer can only perform its intended function when the unit is in proper operating condition.

To insure proper operation, both Double Check Valves and Reduced Zone Valves should be tested periodically. How often should this be done? Possibly once a week to once a month on systems passing large quantities of foreign materials; never less than once a year; and at least as often as required by local code.

The following procedures for testing both the DC Models and RZ Models utilize a commercially available test instrument, but other types of pressure differential meters or dual pressure gauges may also be utilized to accomplish the same purpose. Check local codes for any variation from these testing techniques. Make sure that the testing instrument being utilized is in proper working order and calibrated.

Test No. 1 and Test No. 2 apply to both DC and RZ Models. Test No. 3 applies only to RZ Models and may be performed after first two tests.



## Warranty

Seller warrants for a period of one year from date of installation that the product is free from defects in materials and workmanship. SELLER MAKES NO OTHER REPRESENTATION OR WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, THE WARRANTY OF MERCHANTABILITY OR THE WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL SELLER BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES. The limit of Seller's liability for failure of the product to meet this Warranty shall be, at Seller's option, to either repair or replace the defective product. Seller shall have no responsibility whatsoever for losses resulting from faulty installation, improper application or misuse of the product, or from foreign material lodged beneath valve seats which prevent proper functioning of any working part.

# INSTALLATION DATA

The Lawler ITT line of Backflow Preventers are quality engineered to offer the best products of this type in the field of contamination prevention control. In order to receive the maximum benefits from these products, it is important that you:

1. follow all of the local codes which may apply.
2. follow the installation, testing and servicing instructions carefully.

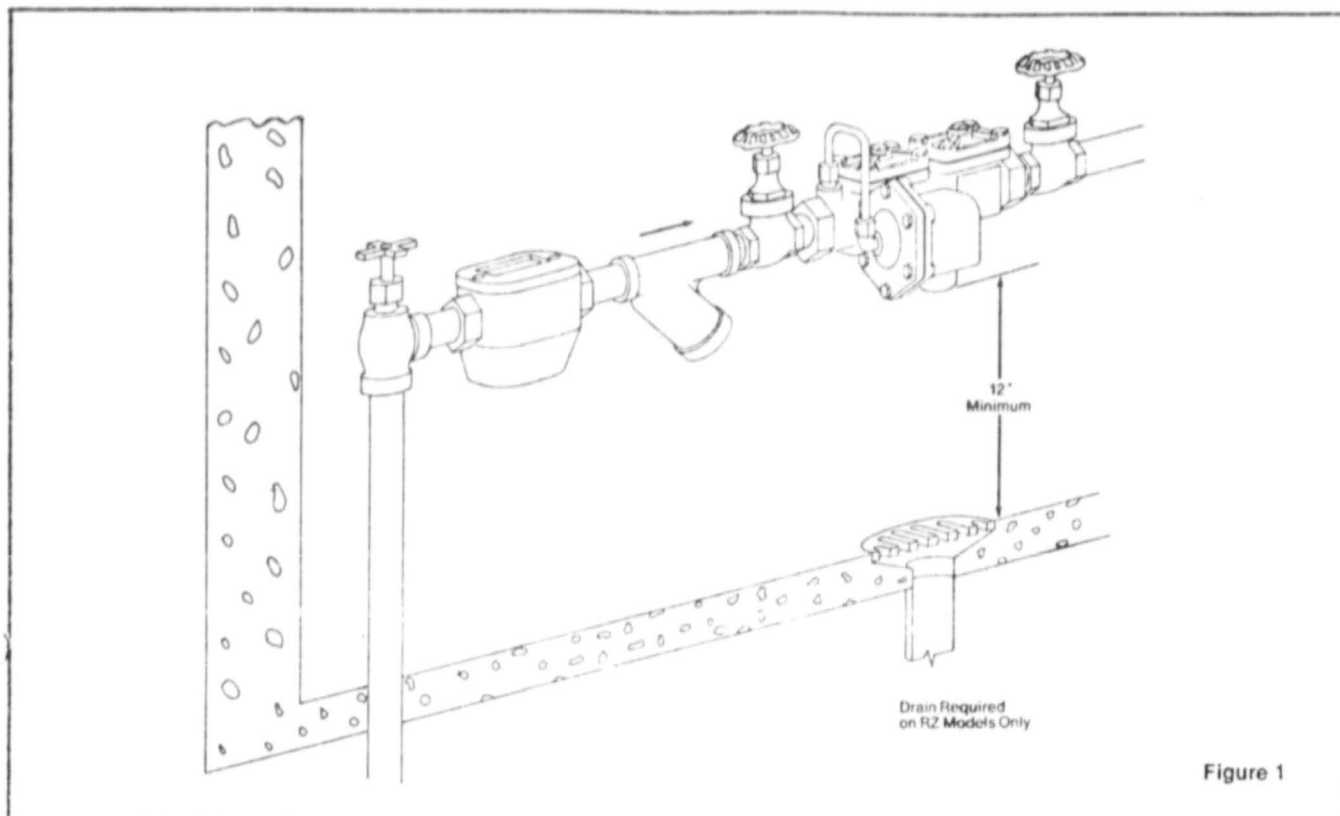


Figure 1

## Installation Instructions

### Double Check Models and Reduced Zone Models

1. The Lawler ITT Backflow Preventers may be installed either indoors or outdoors providing the temperatures *never* approach freezing.
2. Both the Double Check models and the Reduced Zone models should be protected on the incoming water supply by a strainer. All of the Lawler ITT models are available with such a strainer, if desired. (See Catalog listings.)
3. Select a location which is readily accessible for future testing, servicing, etc. A location such as a drain pit or ground depression is *not* recommended because of possible flooding. (See Dimensions on page 8.)
4. The Lawler ITT Backflow Preventers should be installed in a horizontal position wherever possible, but may be installed in any position where the flow direction would be downward. Check local code requirements for any special situations.
5. On RZ models (Reduced Zone Type) make sure that the discharge outlet from the Relief Device is

located at least 12 inches above the floor, drain or ground. No piping should be connected to this unthreaded discharge opening. (It is recommended that a controlled drain be located under the vent port of the Relief Valve.) If the Relief Device is to be discharged into auxiliary piping to a remote drain, then there should be an air gap of at least 4 inches between the discharge opening and the auxiliary piping.

NOTE: During the *normal* operation of an RZ Model (Reduced Zone Type), there can be occasional operation or dripping of the relief valve assembly. This can be caused by sudden changes in pressures (from water hammer, solenoid valve closure, flush valves, etc.). A water hammer arrester installed just upstream from the source causing the pressure change will help to keep this problem to a minimum.

If leakage is continuous then the relief valve or one (or both) of the check valves may be fouled. (See Servicing Procedures.)

### TEST No. 1

*Purpose: To test No. 1 Check Valve for tightness against reverse flow.*

1. To start test, Gate Valve #1 should be open and Gate Valve #2 should be closed.
2. All Test Cocks should be closed.
3. Install test equipment as shown in diagram with all instrument Control Valves closed. Hose to Test Cock #4 should *not* be attached at this time.
4. Vent air from hoses and gauge. (To vent, open Test Cocks #2 and #3, open "Vent" Control Valve, open "High" Control Valve until air is expelled, and then close. Open "Low" Control Valve until air is expelled, and then close. Alternately open and close Bleed Valves expelling air in gauge.)
5. With both "High" Control Valve and "Low" Control Valve closed, note reading on meter.
6. If pressure differential shown on meter is maintained, then Check Valve No. 1 can be considered "Closed Tight."
7. If pressure differential shown on meter drops, then Check Valve No. 1 is "leaking." (See Service Instructions.)

### TEST No. 3

*Purpose: To test operation of Pressure Differential Relief Valve which must maintain the zone between the two check valves at least 2 psi less than the supply pressure.*

1. To start test, Gate Valve #1 should be open and Gate Valve #2 should be closed.
2. All Test Cocks should be closed.
3. Install test equipment as shown in diagram with all instrument Control Valves closed. Hose to Test Cock #4 should *not* be attached at this time.
4. Vent air from hoses and gauge. (To vent, open Test Cocks #2 and #3, open "Vent" Control Valve, open "High" Control Valve until air is expelled, and then close. Alternately open and close Bleed Valves expelling air from Gauge.)
5. Open "High" Control Valve.
6. Open "Low" Control Valve *very slowly* until needle on gauge begins to drop. Hold valve in this position until Differential Relief Valve begins to drip. Note gauge reading at that moment.
7. Differential Relief Valve is operating properly if gauge reading is not less than 2 psi.
8. If gauge reading is less than 2 psi, then valve must be disassembled for inspection. (See Service Instructions.)

### TEST No. 2

*Purpose: To test No. 2 Check Valve for tightness against reverse flow.*

1. To start test, Gate Valve #1 should be open and Gate Valve #2 should be closed. Test Cocks #2 and #3 should still be open and all instrument Control Valves closed.
2. At this point, connect hose to Test Cock #4 and open Test Cock.
3. Observe differential pressure reading on gauge.
4. Open "High" Control Valve and "Vent" Control Valve.
5. If gauge maintains pressure differential reading, then Check Valve No. 2 can be considered "Closed Tight."
6. If gauge reading drops, then Check Valve No. 2 is "leaking." (See Service Instructions.)

---

### ALTERNATE TEST PROCEDURE FOR CHECK VALVES ONLY

**NOTE:** Can be utilized where no meter is available, but this test procedure may not be acceptable to local codes.

*Purpose: To test No. 1 and No. 2 Check Valves for tightness against reversed flow.*

1. Using a 3 ft. section of hose, connect it between Test Cocks #1 and #3.
  2. Close Gate Valve #1 and Gate Valve #2.
  3. Open Test Cocks #1 and #3.
  4. Slowly open Test Cock #2. Other than initial leakage, if there is no further flow from Test Cock #2, then Check Valve No. 1 is tight.
  5. If leakage continues from Test Cock #2, then Check Valve No. 1 is leaking. (See Service Instructions.)
  6. Close all Test Cocks and place hose between Test Cocks #1 and #4.
  7. Open Test Cocks #1 and #4.
  8. Slowly open Test Cock #3. Other than initial leakage if there is no further flow from Test Cock #3, then Check Valve No. 2 is tight.
  9. If leakage continues from Test Cock #3, then Check Valve No. 2 is leaking. (See Service Instructions.)
-

# SERVICING INSTRUCTIONS

## To Inspect Check Valves on DC and RZ Models

1. Close gate valves on each end of unit.
2. Remove square casting cover from top of Check Valve No. 1 chamber. (Figure 9.) Check Valve No. 1 is located on inlet side of unit.
3. Carefully slide back stainless plate beyond the latch and slowly raise plate and remove attached assembly along with the spring. (Figures 10 and 11.)
4. Place the end of a screwdriver under upper lip of check valve seat, and assembly should pop out into chamber. Be very careful not to scratch seating surface or nick soft seating disc. (Figure 12).
5. Examine seating disc and seating surface for foreign materials or damage. (Figure 13.) Replace seating disc assembly, if necessary. (See Parts, Page 8.) If bronze body seat is damaged, then complete replacement of Backflow Preventer is necessary.
6. Check Valve No. 2 may be examined in the same manner. The seating assembly can very easily be popped out of casting by pushing through with a finger from Check Valve No. 1 Chamber.
7. To reassemble, first re-insert valve seating assembly.

NOTE: On RZ unit models, the Check Valve No. 1 spring is stainless steel, and Check Valve No. 2 spring is bronze. These springs must *not* be interchanged.

8. Place one end of spring in housing of stainless plate assembly, and by placing a finger under other end of spring, carefully guide spring into recessed opening on valve seat assembly. (Figure 14.) Compress spring sufficiently to drop stainless plate assembly into chamber. (On  $\frac{3}{4}$ " or 1" models, a screwdriver or long-nose pliers may be required to replace spring.)
9. With flat end of stainless plate pivoted on centerline of chamber opening, push round end of stainless plate down onto casting and slide latch into place.
10. Center the stainless plate assembly. (Check again to see that spring is still properly fitted into valve seat assembly.)
11. Replace gasket and casting cover, replace bolts and tighten. Open gate valves. Retest unit.

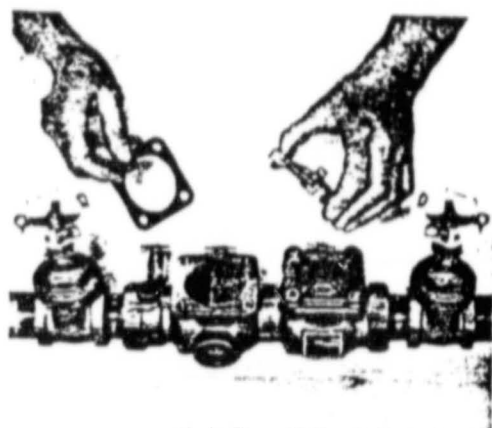


Figure 9



Figure 10

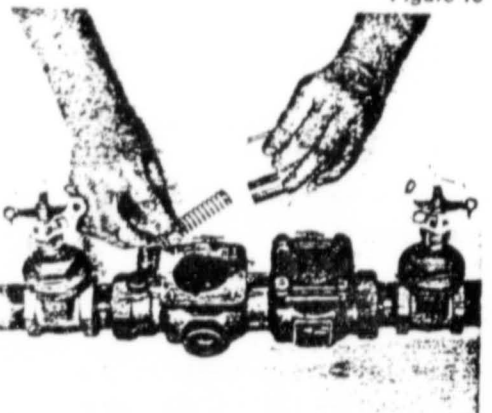


Figure 11

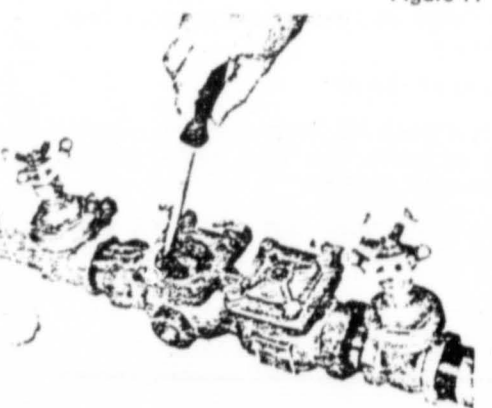


Figure 12

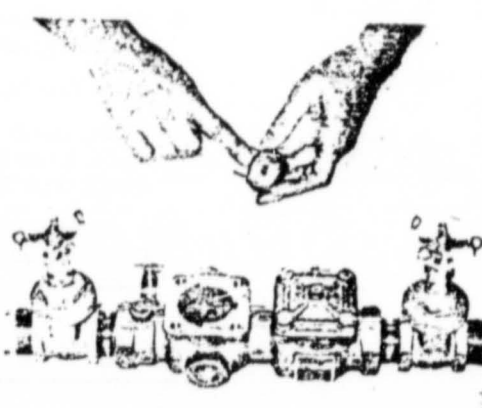


Figure 13

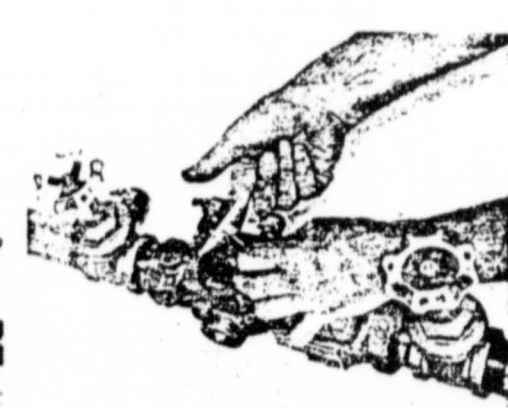


Figure 14



Figure 15

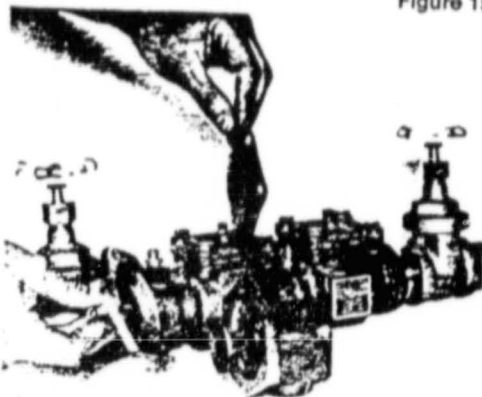


Figure 16

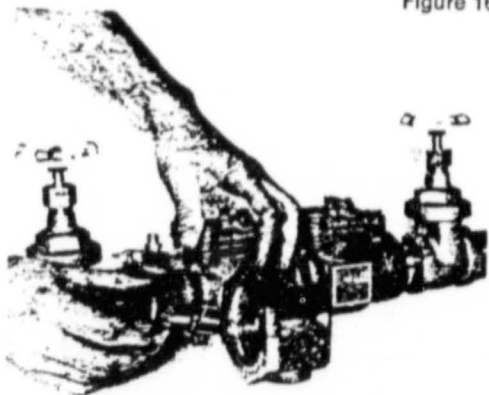


Figure 17

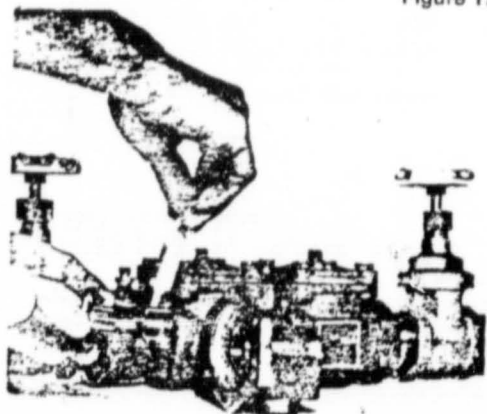


Figure 18

## To Inspect Relief Valve on RZ Models

1. Close gate valves on each end of unit.
2. Loosen nuts on ends of 1/4" tubing and remove tubing. (Figure 15.)
3. Remove the 6 bolts from end of Relief Valve.
4. Remove housing cover, being careful not to damage diaphragm. (Figure 16.)
5. Firmly grasping the round flat metal plate, slowly pull complete assembly straight out of base casting. (It is very important that the two sets of guiding prongs do not scratch the seating surfaces.) Remove spring. (Figure 17.)
6. Examine both the flat elastomer seat and the O-ring seat for signs of foreign material or damage. Replace assembly if damaged. Examine Diaphragm for signs of damage (See Parts, Page 8).
7. Also check stainless seat and O-ring bore for foreign material or damage. Relief valve must be replaced if either seat is damaged.
8. To reassemble, first apply a liberal amount of silicone grease into the O-ring bore and in the stainless seat bore. Also apply to O-ring. (Figure 18.)
9. Place spring in end of seating assembly and very carefully slide assembly into casting.
10. Pushing the seating assembly all the way in, insert a 1/2" open end wrench into the discharge opening of the Relief Valve so that the wrench locks the spring assembly in the compressed position. (Figure 19.)
11. While applying back pressure on the end wrench to hold spring assembly in its most compressed valve closed position, place diaphragm (concave side toward spring assembly) onto brass housing cover and replace bolts. (Figure 20.) *Continue to compress spring assembly until all 6 bolts have been tightened.* (Prevents slippage of diaphragm and possible leakage.)
12. Remove wrench. Replace 1/4" tubing. Open gate valves. Retest unit.

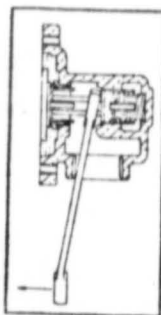


Figure 19 (From below)

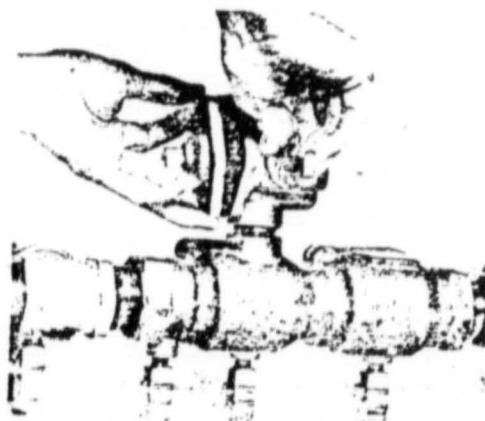
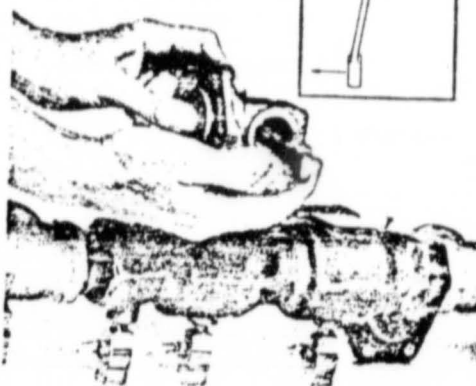


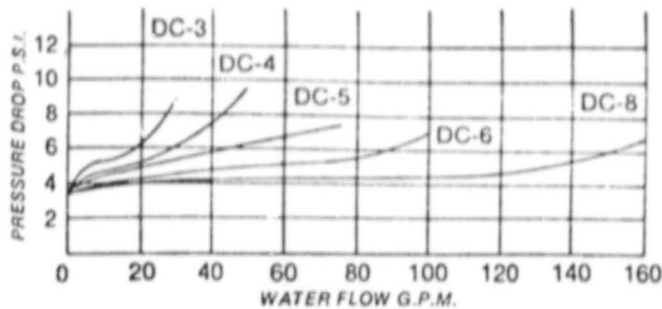
Figure 20 (From below)



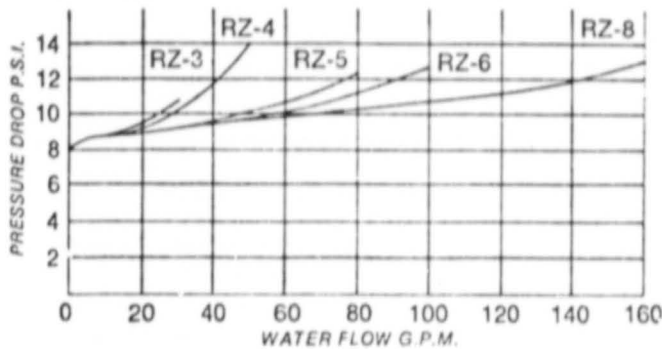
## CAPACITY CURVES

(Not including shut-off valves or strainers)

### Lawler Double Check Backflow Preventer



### Lawler Reduced Zone Backflow Preventer



### Pressure Drop through Valves & Strainers

Note:  $\left(\frac{Q}{C_v}\right)^2 = \Delta P$

Q = Flow gpm

$\Delta P$  = Pressure Drop psi

- For additional pressure drop at given flow determine  $\Delta P$  using above formula and  $C_v$  values from chart.

- Add calculated  $\Delta P$  to pressure drop as shown on model curves for total pressure drop.

Pipe Size (NPT)	$C_v$ Valves* & Nipples	$C_v$ Strainers**
3/4	19.49	13.7
1	52.70	19.1
1 1/4	72.13	30.0
1 1/2	111.11	54.0
2	216.93	62.0

\*Valves wide open.

\*\*Strainers new and clean.

## REPLACEMENT PARTS

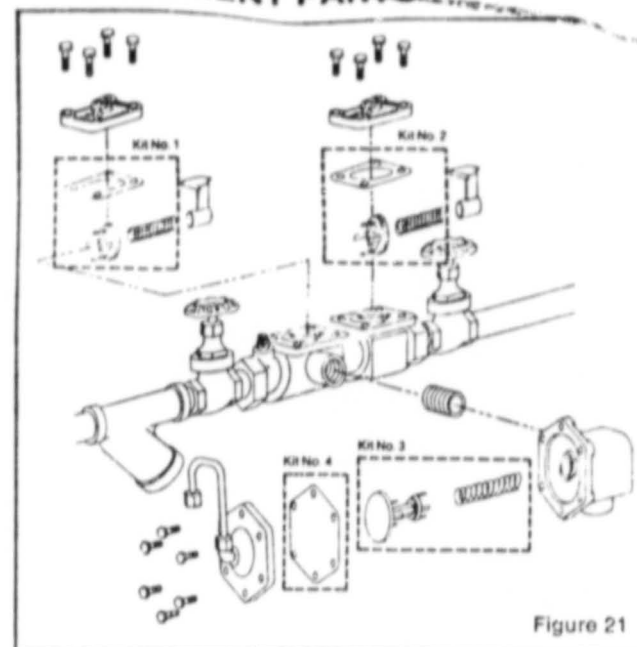


Figure 21

### For Double Check Backflow Preventers

Model No.	Kit No. 1 or Kit No. 2 (Identical)
DC-3 & DC-3-S	300100
DC-4 & DC-4-S	300110
DC-5 & DC-5-S	300120
DC-6 & DC-6-S	300130
DC-8 & DC-8-S	300140

### For Reduced Zone Backflow Preventers

Model No.	Kit No. 1 (Stainless Spring)	Kit No. 2 (Bronze Spring)	Kit No. 3	Kit No. 4
RZ-3 & RZ-3-S	300150	300100	300200	300220
RZ-4 & RZ-4-S	300160	300110	300200	300220
RZ-5 & RZ-5-S	300170	300120	300200	300220
RZ-6 & RZ-6-S	300180	300130	300200	300220
RZ-8 & RZ-8-S	300190	300140	300210	300230

## DIMENSIONS (Inches)

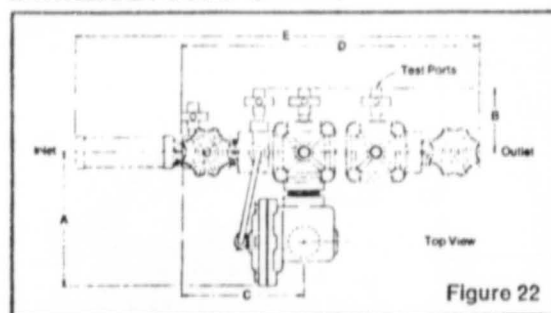


Figure 22

### Double Check Models

Model No.	B	D	E*
DC-3 & DC-3-S	2 1/16	12 1/16	17 1/16
DC-4 & DC-4-S	2 1/16	13 1/16	18 1/16
DC-5 & DC-5-S	3 1/16	16 1/16	22 1/16
DC-6 & DC-6-S	3 1/16	17 1/16	24 1/16
DC-8 & DC-8-S	3 1/16	20 1/16	28 1/16

\*Models with Strainers

### Reduced Zone Models

Model No.	A	B	C	D	E*
RZ-3 & RZ-3-S	5 1/16	2 1/16	5 1/4	12 1/16	17 1/16
RZ-4 & RZ-4-S	5 1/16	2 1/16	5 3/8	13 1/16	18 1/16
RZ-5 & RZ-5-S	6	3 1/16	6 1/8	16 1/16	22 1/16
RZ-6 & RZ-6-S	6	3 1/16	6 3/4	17 1/16	24 1/16
RZ-8 & RZ-8-S	7 1/16	3 1/16	7 1/2	20 1/16	28 1/16

\*Models with Strainers

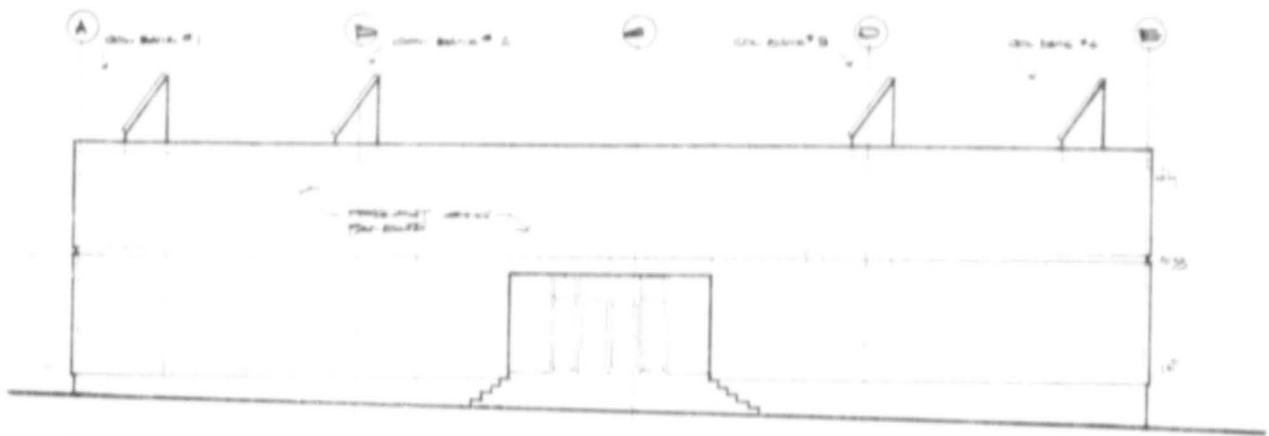
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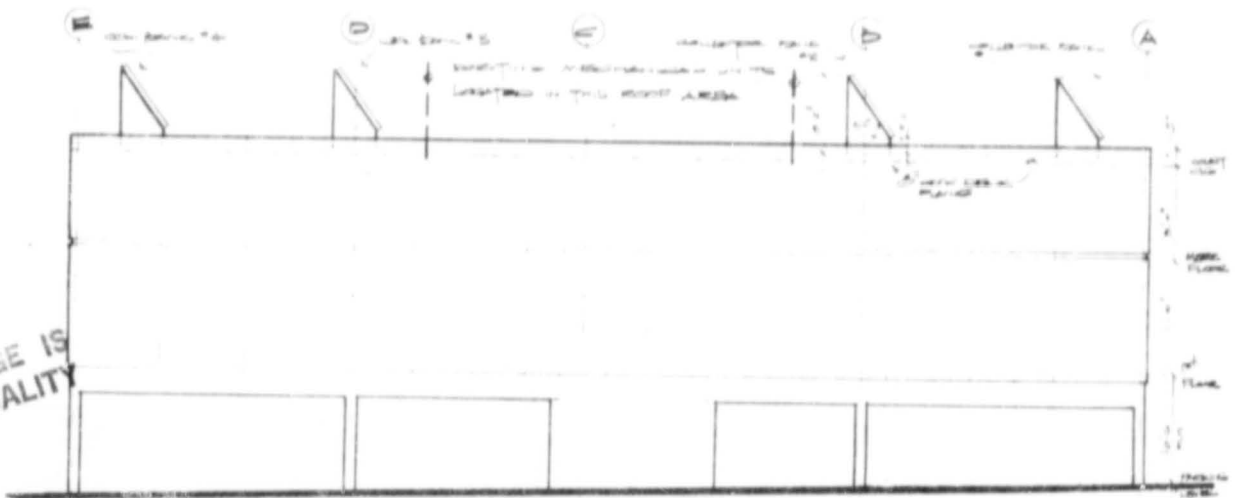
# LAWLER

Telephone: (412) 463-0222

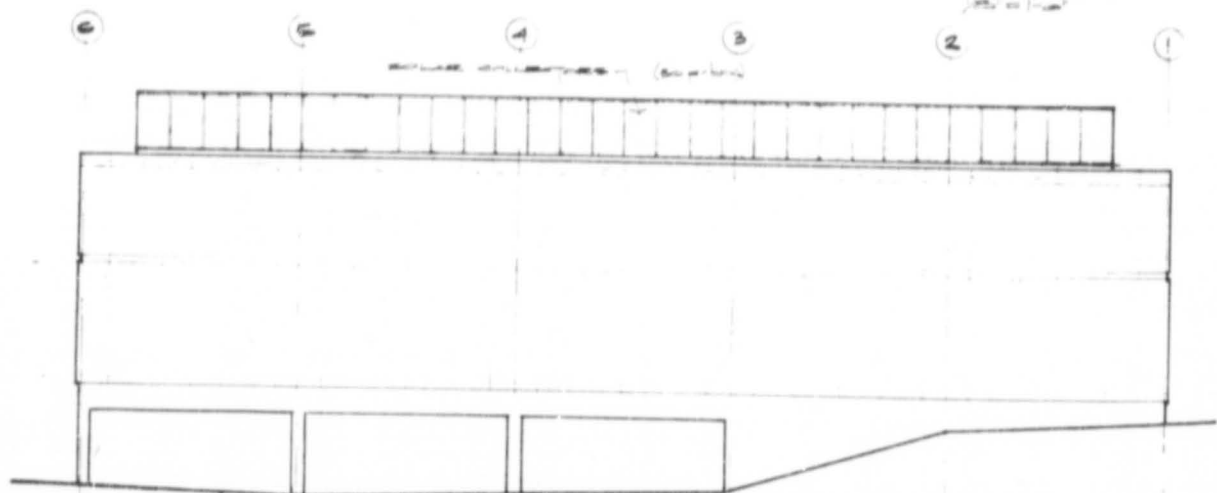
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EAST ELEVATION



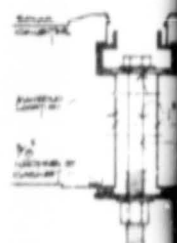
WEST ELEVATION



SOUTH ELEVATION

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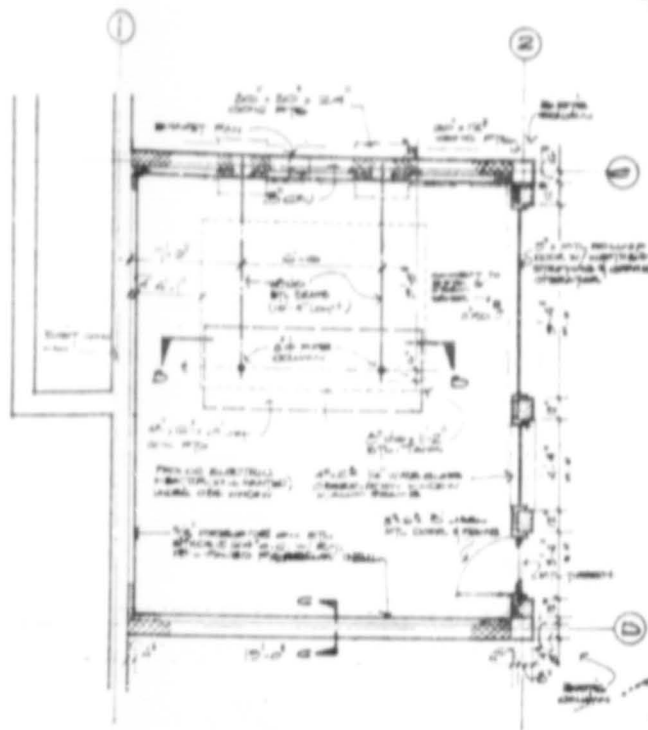
FOLDOUT FRAME



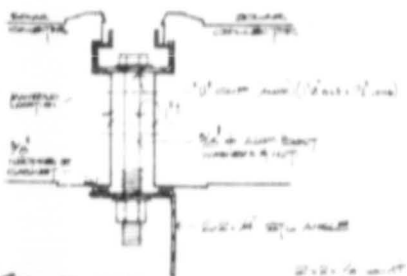
MOUNTING DETAIL



Roof Plan  
1/2" = 1'-0"

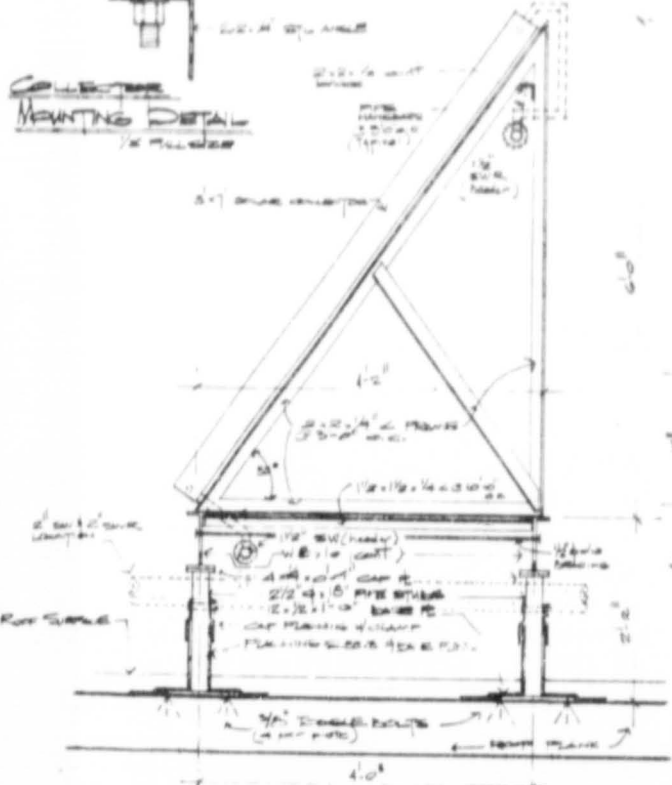


Sole Equipment Room Plan  
1/2" = 1'-0"



Mounting Detail  
1/2" = 1'-0"

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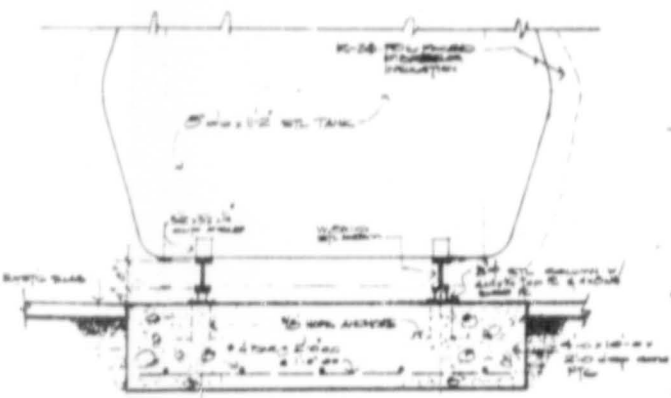


Section A-A  
1/2" = 1'-0"

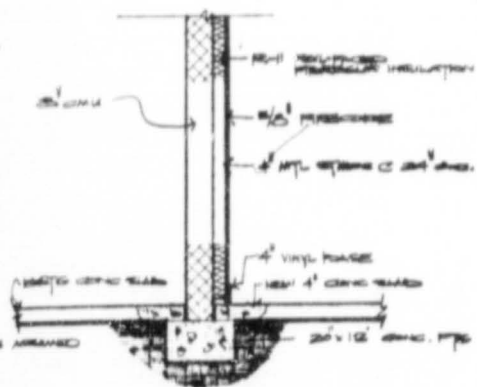


Section B-B  
1/2" = 1'-0"

NOTE:  
SOIL BEARING VALUE ASSUMED  
TO BE 1000 P.S.F.



Section C-C  
1/2" = 1'-0"



Section D-D  
1/2" = 1'-0"

FOOTOUT FRAME  
2

THE RUST SOLAR COMPANY  
P.O. BOX 1000  
ALBUQUERQUE, N.M.

PROJECT NAME: THE RUST CONSTRUCTION OF  
SOLAR RADIANT HEATING BY LARS ANDERSON  
ARCHITECTS CONSULTING ENGINEERS AND  
ARCHITECTS 122 KIRKWOOD ROAD  
ALBUQUERQUE, NEW MEXICO 87105

ALBUQUERQUE RADIANT HEAT  
CLUB  
122 KIRKWOOD ROAD  
ALBUQUERQUE, NEW MEXICO 87105

DATE: 10/1/78  
BY: [Signature]

SCALE: 1/2" = 1'-0"

341







FD-302a (Rev. 11-29-10)

SOLAR STORAGE TANK

### EXPANSION TANK

人非圣贤孰能无过！

Stacy Heat Engine

### DOMESTIC HOT WATER HEAT EXCHANGER:

PRESENTING CASE 611

1947-1948

Problem 3 *Medium* *System* = 1000000000

Planes: P-1 & P-2

SWP P-2:

PUMP NO.	GPM	HEAD	% EFF.	HP	RPM
P-1	25	50	45%	1	1750
P-2	20	45	32%	1	1750
P-3	7	25	40%	1/4	1750

LONG :

GATE VALVES:

FLOW CHECK VALVES:

### ENGINE VALVES:

STRAINERS:

THREE-WAY VALUES:

### TEMPERING VALVES:-

INSULATION:

Back Flow Prevention:

STAINLESS STEEL

FOLDOUT FRAME

